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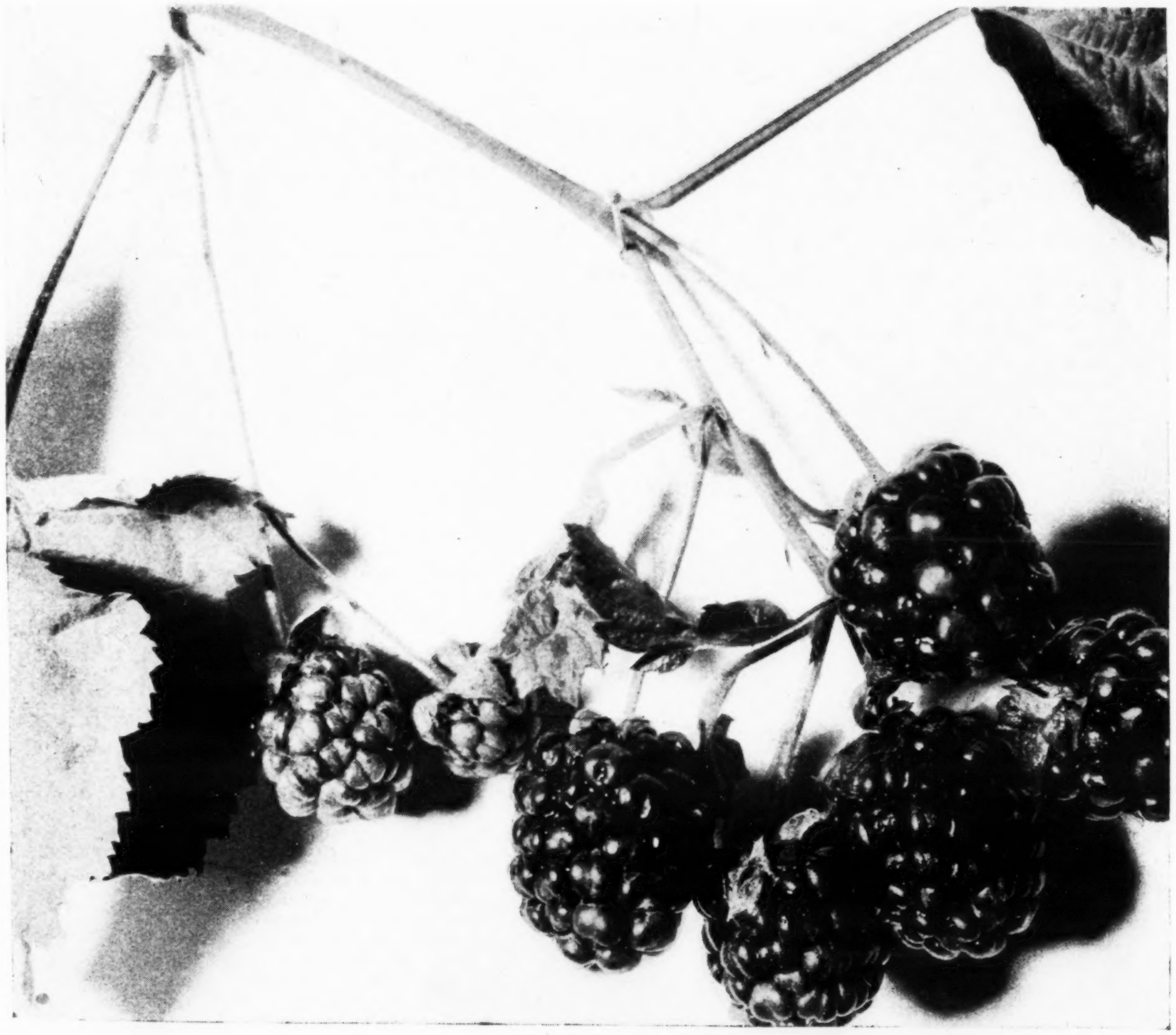

**THORNLESS DEWBERRIES**

(SEE PAGE 567)

*Zebra-Horse Hybrid*

*Bantam Genetics*

*Index to Volume XX*

VOLUME 20 DECEMBER, 1929 NUMBER 12

# The American Genetic Association

***An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks***


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*The*

# Journal of Heredity

Vol. XX DECEMBER, 1929 No. 12

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### *Poultry Genetics*

**Inheritance or hen-feathering in the male, and of side-sprigs, crests and other characters.**

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### *Marriage Prospects of Graduates*

**Of the Southern Women's Colleges.—Do they differ from those reported from colleges in the North?**

### *Parted Parietals*

**An inherited skull variation in mice.**

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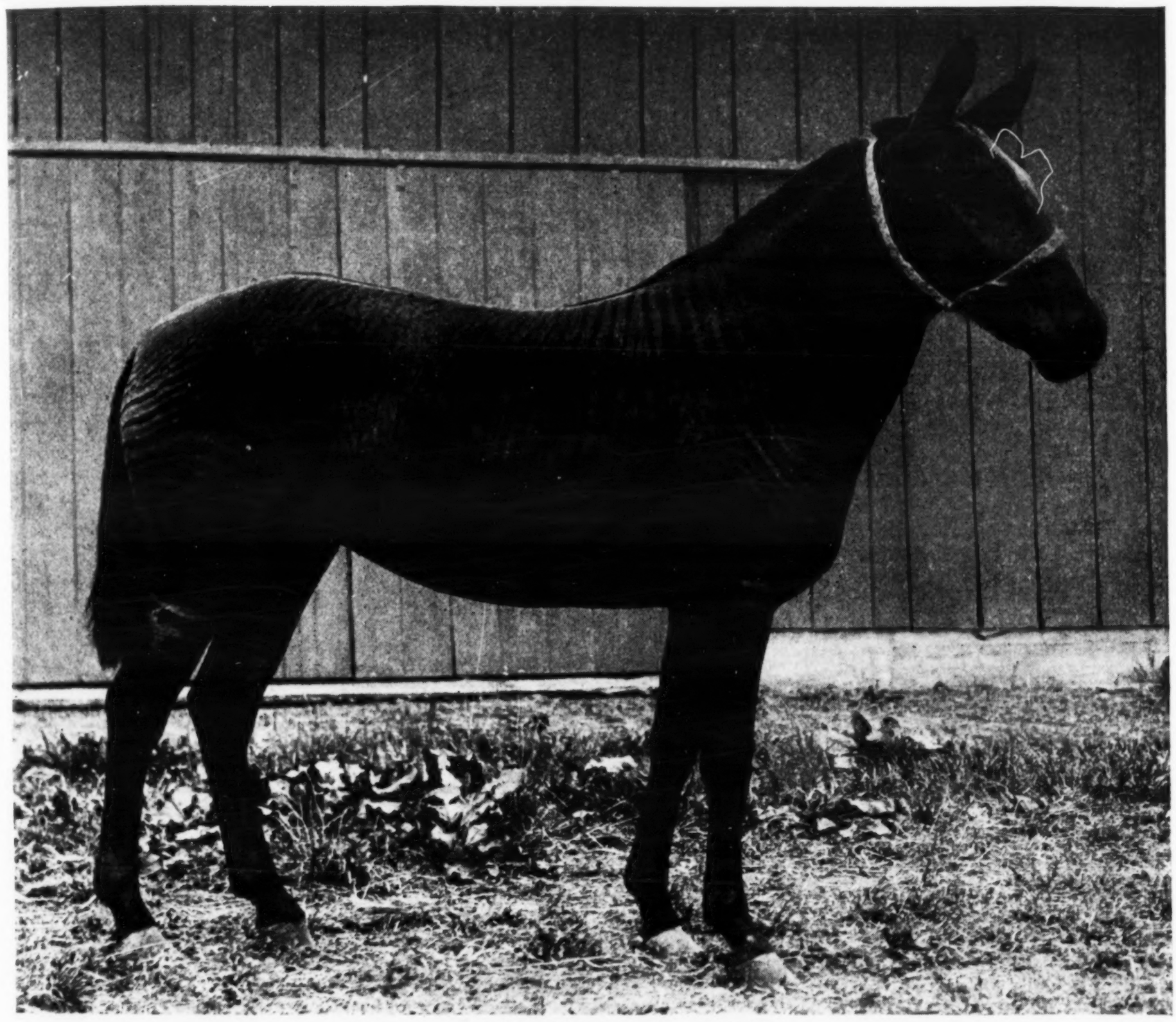
**A GROUP OF TWO-YEAR OLD ZEBROIDS**
**Frontispiece**

Their sire a Grevy zebra, their dame a mare, the zebroids are well-formed, gentle, and intelligent. This cross offers definite possibilities in the production of better domestic animals.

# A ZEBRA-HORSE CROSS

ELMER ROBERTS
*University of Illinois*



**A HANDSOME ZEBROID**
**Figure 1**

A beautiful two-year-old speciment produced by crossing zebra and mare. The zebroids all have a chocolate ground-color and black stripes, regardless of the color of the mother. Their sire a Grevy zebra, their dame a mare, the zebroids are worthless, in the production of better domestic animals.

ROMMEL in 1913 described in detail the work of the Bureau of Animal Industry in crossing the Grevy zebra (*Equus grevii*) with the ass and the horse.[3] Direct matings with the ass were successful but unsuccessful with the horse. In the experiments of Ewart[1] the Burchell zebra was used successfully in direct matings with horses.

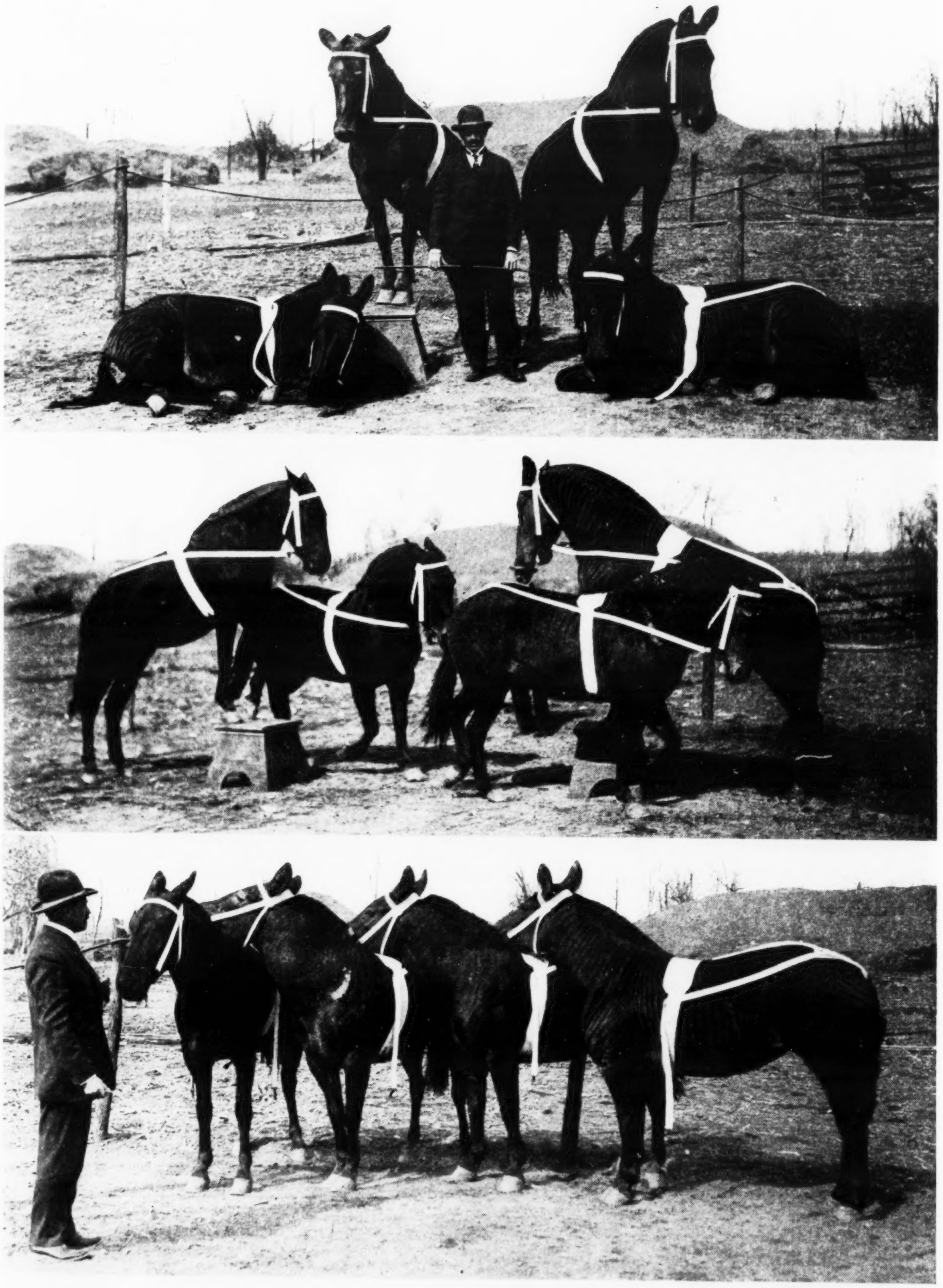
After the conclusion of the experiment by the Bureau of Animal Industry, Dr. W. E. Hasting of Mt. Vernon, Indiana, who furnished the information herewith reported concerning his experiment, brought from Germany in 1912 a pair of Grevy's zebras, a stallion ten months old, and a mare eighteen. This species of zebras was selected because of its larger size and seemingly greater docility than that of other zebras.

According to Dr. Hasting they were wild when he procured them, but by spending considerable time with them during the voyage home, the stallion became quite tame, eating oats from hand

A ZEBROID FAMILY

**Figure 2**

The male Grevy zebra used in the experiments, and (below) one of the hybrid zebroids with its mother. The Grevy zebra was chosen because it is larger than the other species of zebras.



**TRAINED ZEBROIDS**

**Figure 3**

The zebroids can be trained as shown by the positions above. They stand hot weather better than other draft animals.

and lying down. The mare was not known to lie down on the trip and died a few months after reaching Mt. Vernon from a fractured skull, the cause unknown.

Quoting from a letter from Dr. Hasting:

> The stallion was placed in a stall with a mare colt of same age, where he was kept until he had reached the age of sexual desire. Much time was spent on this stallion, but it was a bit hard to teach him restraint, and for that reason, when he was two years old, I put him in harness and worked him to harrow and drag for twelve days. He served his first mare on May 4, 1916. After that time, it was no trouble to get him to cover and he was handled in every way as you handle any jack or stallion.

In 1916 thirty mares were bred directly to the male zebra or artificially inseminated by means of capsules. Twenty of these were settled in foal. During the early part of 1917 the mares contracted "shipping cold" brought in by a shipment of mules, causing eighteen of the twenty pregnant mares to abort. Only one of the two colts was raised to maturity. The next year seven hybrid colts or zebroids were produced from both direct and capsule breeding. Of the eight hybrids four were from direct matings and four from artificial impregnation. Of these hybrids three were males and five were females. All were sterile.

The zebra sire weighed about 900 pounds, the dams 1000 to 1600 pounds and the hybrids weighed from 1000 to 1200 pounds. In color all the zebroids were chocolate with black stripes though the dams were of various colors, bay, black and gray.

According to Dr. Hasting they were gentle, good workers, and could stand hot weather better than any other animals he had ever had on his farm. They were intelligent, well formed and beautiful in appearance as can be seen from an inspection of Frontispiece and Figure 1. Their gentleness and susceptibility to training are indicated in Figure 3.

For this interesting experiment in crossing two different species a great deal of credit is due Dr. Hasting, who, over a period of several years, devoted his energy, time and money in order to obtain information as to the possibility of using the zebra in the production of better domestic animals.

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## The Vanishing Child

IN a previous letter (*The Journal*, October 12, p. 1156), the profound change in the population, which consists of an increased proportion of the old and a diminished proportion of the young, was described. Figures now given by the Education Committee of the London County Council illustrate this change in a striking way. There are 48,943 fewer children of elementary school age in London than two years ago. Since 1915 the total number of children has declined from 898,439 to 717,917. The number of children born in 1914 who survived was 99,497; in 1918 in consequence of the war the figure had fallen to 64,998. In 1920 the figure was 113,539, but in 1928 it had fallen to 67,473.

*Jol. American Med. Assoc.*

# SINGLE AND SEMI-DOUBLE FLOWERS IN PHLOX

J. P. KELLY
*Pennsylvania State College*

**SEMI-DOUBLE AND SINGLE FLOWERS COMPARED**

**Figure 4**

On left is shown the type of semi-double flowers used in all crosses. The petal number averaged nine or ten per flower. On the right is shown the type of single flower used in Case 2 crossings. The single flower strains used averaged slightly over five petals per flower, because of the occurrence of occasional six petalled flowers.

THE commonly cultivated annual phlox (*Phlox drummondii*) occurs in a large number of varieties, the great majority of which possess flowers that are termed *single*. The single flower has but one set of petals, usually five to the set. In a certain long inbred line of single phloxes of the variety *alba*, for example, 54 flowers were taken, of which 51 had five petals and three showed six petals, an average of 5.05 petals per flower. This may be taken as more or less typical of single-flowered plants.

In the horticultural evolution of *Phlox drummondi* extra-petalled varieties have arisen called the *semi-double* phloxes in which the number of petals per flower may range from seven to twelve on one and the same plant. (See Figure 4.) The petal number for the semi-doubles used in the hybridization studies here described averaged nine or ten per flower. The extra petals are often of different sizes but in these experiments each was counted a unit no matter what its size. The additional petals are not developed at the expense of stamens or carpels and these semi-double sorts can be used as either the male or female parent in crossings.

## The First Generation Hybrids ($F_1$)

Hybridization revealed that crossings of singles and semi-doubles

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yielded $F_1$ results of different types:

*Case 1.* The pollen parent was of a line descended from the plant shown in Figure 5 designated in our records as $J_{15}$. It was a typically single-flowered plant with white- and pink blade, of the commercial variety *Dwarf Surprise*. Petal counts on seven of the flowers of $J_{15}$ showed that each had five petals. The line has been under observation for a number of seasons and is known to be single, although petal counts were not recorded for later generations. The semi-doubles used as parents have already been described. (See Figure 4 again.) The $F_1$ generation was a group of nineteen uniform-looking plants. Ten flowers, if possible, on each plant were taken and their petals or corolla lobes counted to establish the average corolla number for a plant.

**A SINGLE-FLOWERED PLANT**

**Figure 5**

A typical plant of the variety *Dwarf Surprise*. The individual in this photograph is $J_{15}$, progenitor of line used in the crossings of Case 1.

In the crossing of the semi-double and the single sort just referred to, the entire $F_1$ group of 19 plants bore single flowers. This means complete dominance of the single condition. (See Table I.)

*Case 2.* In this group the character semi-doubleness was introduced through the same pedigree line. The character singleness, however, was furnished by a line of pure whites (see Figure 4) that had been previously inbred for several generations. From the progeny (from selfing) of the particular single used as parent in crossing 1 of Case 2 fifty flowers were taken randomly on six plants and an average petal number of 5.06 per flower was ascertained. Eighty-two flowers similarly taken from among the progeny of the semi-double used gave an average of 9.86 petals per flower.

The combining of these two strains (see Table I, crossing 1) yielded three individuals whose petal averages were 5.56, 5.90 and 6.00 per flower. Two other $F_1$ plants arose (crossing 2 of Case 2 in Table I) from the same double and a plant that was a sib of

the single used; the latter $F_1$ hybrids had floral averages of 6.11 and 6.30.

*Case 3.* A semi-double white-flowering plant of the same pedigree line as the semi-doubles previously mentioned served as seed parent. Eleven of its flowers gave a petal average of between 10 and 11. The pollen parent was a pink streaked *funnel-flowered* plant of a strain several years in cultivation and known to be single (see Figure 7) although no petal counts were made of it. Twenty-one $F_1$ plants (See Case 3 of Table I) similar in color and pattern were raised and the petal number for the family averaged between seven and eight (7.36, to be exact, based on the counting of petals of 329 flowers on the 21 sibs). In Case 3, therefore, the $F_1$ petal number is nearly midway between the single and semi-double types.

*Summary of $F_1$ Results*: The material presented under these three headings deals with crosses between forms all within a single species. The character semi-doubleness was introduced in each crossing through plants of the same pedigree and its development in the immediate progeny was variable depending either on the particular complex of characters accompanying singleness or possibly on the particular kind of singleness that the semi-doubleness was associated with in the $F_1$ zygote.

## The Second Generation ($F_2$)

Do $F_2$ groups from these various $F_1$ cases throw any light on the genotypic situation?

*Of Case 1,* eight different $F_1$ plants on self-pollination gave a total of 235 $F_2$ individuals. Several flowers on each $F_2$ plant were counted, the mean petal number for each plant was determined* and then these individual averages were seriated. The results are shown graphically in Figure 6, Diagram I. There is a great preponderance of the singles. A plant with fully semi-double flowers does not appear, although a number of plants grade over a little in this direction. However, only two of the 235 average as high as seven and a half petals.

*Of Case 2,* four $F_1$ plants on selfing gave rise to an offspring group of 177. The average petal number for each was again determined and the individual averages were classified, giving the curve shown in Figure 6, Diagram II. The mode is close to that of the preceding diagram. In this case, also, no segregate with the semi-double condition appears but the number of plants with petals averaging six or more is greater.

*Case 3* furnished the most illuminating $F_2$ group. Twelve plants of the $F_1$ of Case 3 were self-pollinated yielding an $F_2$ generation of 323 plants. The mean petal number for each of these $F_2$ plants was calculated and the individual averages seriated as before. Figure 6, Diagram III, shows how the 323 plants group themselves with class intervals of the same value as that used in Diagrams I and II. *This is the only one of the three $F_2$ generations that shows fully semi-double*

**TABLE I—Diverse $F_1$ groups derived from crossing single and semi-double phloxes**

| | *Plant Average for Number of Petals per Flower* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type of crossings* | 4.50- | 4.80- | 5.10- | 5.40- | 5.70- | 6.00- | 6.30- | 6.60- | 6.90- | 7.20- | 7.50- | 7.80- | 8.10- | 8.40- | 8.70- | 9.00- |
| Case 1 (Crossing 1) | | 5 | 1 | | | | | | | | | | | | | |
| Case 1 (Crossing 2) | | 8 | | | | | | | | | | | | | | |
| Case 1 (Crossing 3) | | 3 | 2 | | | | | | | | | | | | | |
| Case 2 (Crossing 1) | | | | 1 | 1 | 1 | | | | | | | | | | |
| Case 2 (Crossing 2) | | | | | | 1 | 1 | | | | | | | | | |
| Case 3 | | | | | | 2 | 2 | 2 | | 2 | 7 | 2 | 2 | 2 | | |

*The assistance of Miss Frances P. Gibbons and Mr. Herbert A. Wahl was especially helpful here.

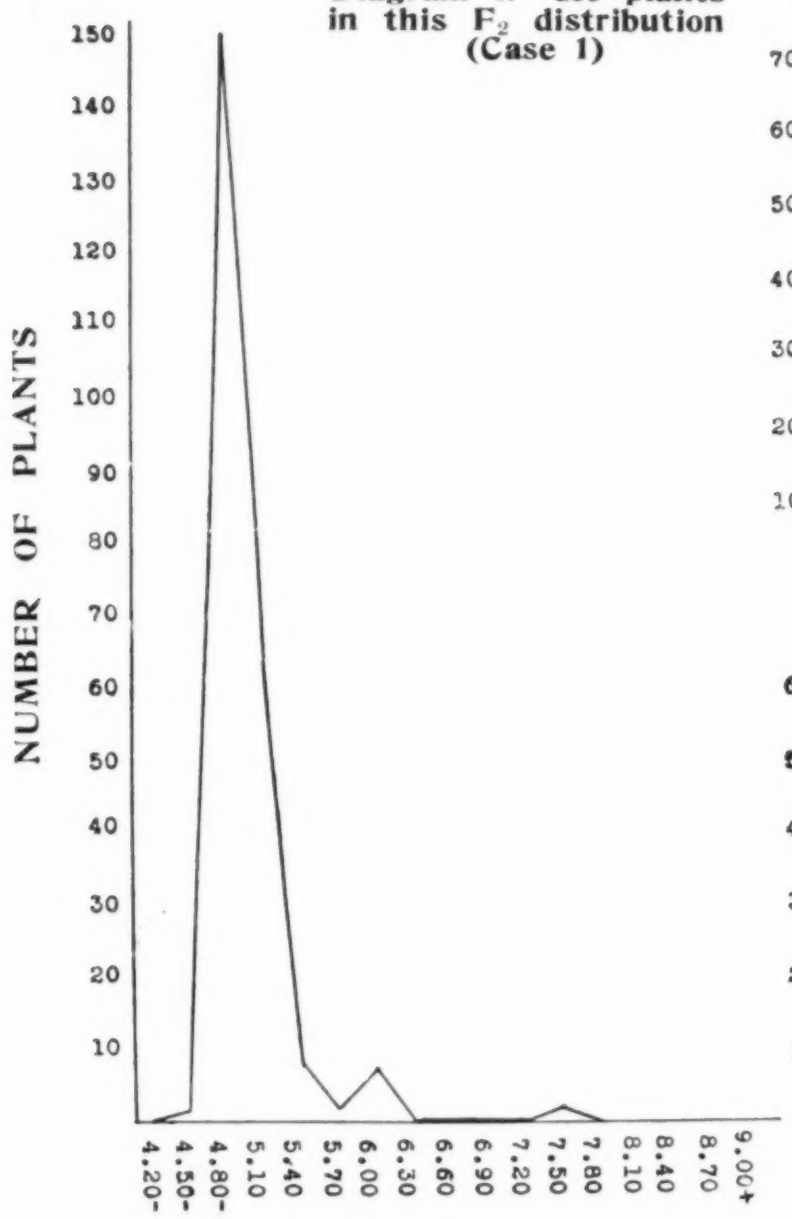


**Diagram I. 235 plants in this $F_2$ distribution (Case 1)**

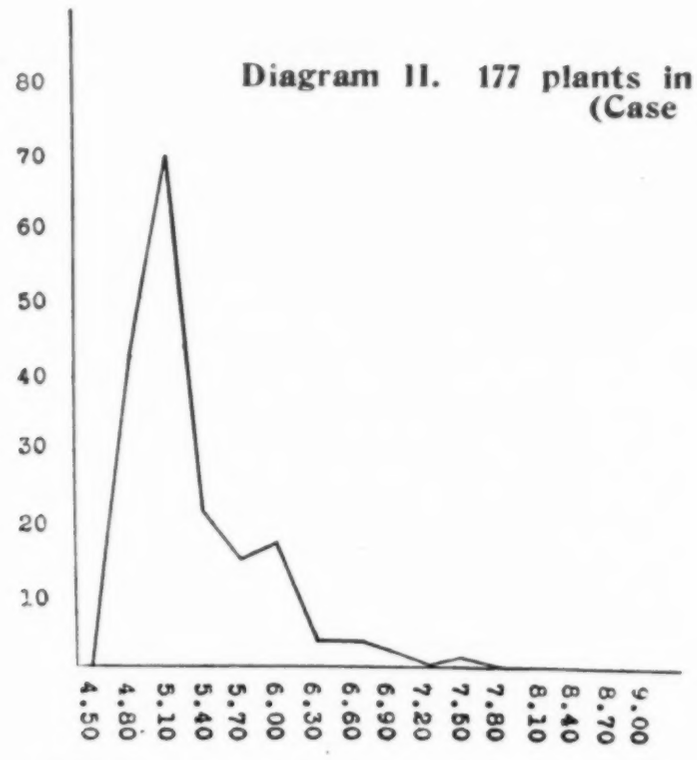


**Diagram II. 177 plants in this $F_2$ distribution (Case 2)**

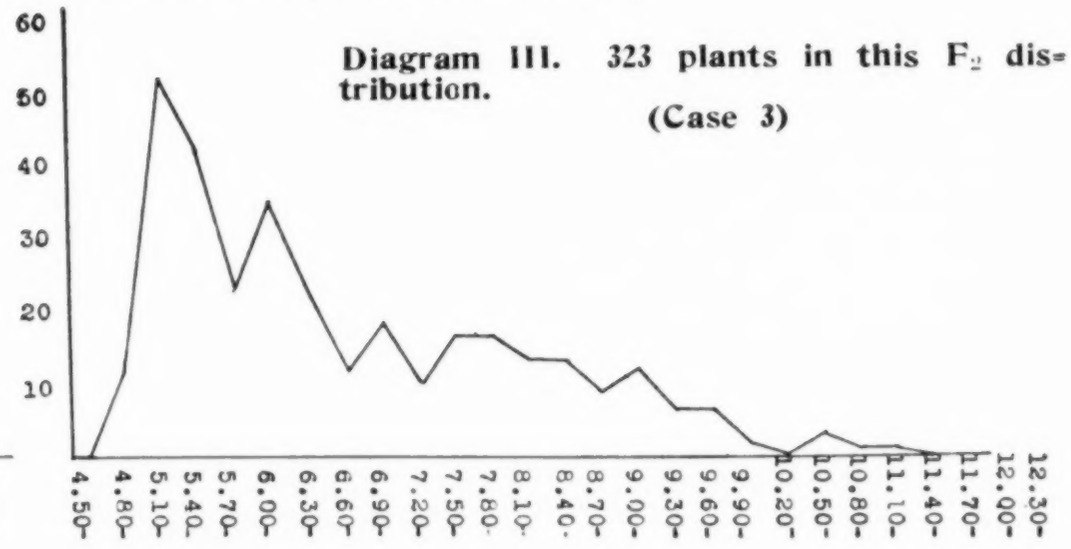


**Diagram III. 323 plants in this $F_2$ distribution.**

**(Case 3)**

**Average petal number per plant**

**DISTRIBUTION IN THE SECOND GENERATION**

**Figure 6**

These diagrams show the number of petals per flower on the plants of the second generation of the three crosses studied. The distributions obtained suggest that two independent cumulative factors are involved, with one or more inhibiting genes complicating the situation in Cases 1 and 2.

*segregates;* that is, segregates resembling the high-petalled grandparent.

### A Provisional Explanation

The interpretation now to be offered is highly tentative and is probably going to remain so indefinitely since the author finds it impossible to pursue this fluctuating characteristic of extra petals into sufficiently large $F_3$ and $F_4$ generations. The distribution of Diagram III suggests that we have here a case of independent cumulative multiple factors recalling somewhat the situation in Nilsson-Ehle's well-known experiments with cereals. It is impossible to state precisely the limits of variation of the truly single and the fully semi-double or of any of the other supposed genetical classes. If we label more or less arbitarily the classes whose petal number is 9.3 or more, as full semi-doubles, this will give us 19 $F_2$ segregates that resemble one grandparent. We may expect a similar number of single segregates. There are 12 in the most extreme minus group, almost certainly singles, and it is reasonable to suppose that other singles, by slight plus fluctuations, entered the adjoining size class or classes. It is not unreasonable to suppose that there may have been a full twenty of the single segregates resembling the fewer-petaled grandparent. On this basis the 323 plants are apportioned thus:

Twenty singles: 284 intermediates: 19 fully semi-doubles, which is very close to Nilsson-Ehle's 1:14:1 ratio. This indicates the interplay of two independent pairs of factors which we may provisionally say produce the

**FUNNEL-FLOWERS**
**Figure 7**

The funnel-flowered variety of single phlox used in the hybridizations of Case 3.

phloxes with extra petals, those whose average centers around 9 or 10 per flower when both pairs of factors are present. The absence of all four factors from the $F_2$ generation of Case 3 gives the single.

The $F_2$ generations of Cases 1 and 2 would seem to indicate also that there are one or more inhibiting genes in *Phlox drummondii* that suppress the activity of the multiple factors for extra petals. In such $F_2$ groups the genes for extra petals would produce their effects only in the relatively few segregates that are without inhibitors.

## Conclusions and Discussion

In conclusion, it would seem that *singleness* of the kind exemplified by the funnel phlox involves the absence of factors that inhibit the production of extra petals, but combined also with an absence of genes of the cumulative kind that bring on the construction of additional petals. This is a negative sort of singleness. On the other hand, singleness of the sort exhibited by the variety *Dwarf Surprise* (i. e., *J*-type) owes its potency in transmission apparently to one or more dominant factors that suppress the activity of genes making for doubleness.

Genetical studies with extra petals have been made in other genera of plants. The character has been proven dominant in *Portulaca* (by Yasuii,[11] but compare Blakeslee,[3]) and in *Petunia*.[6] Doubleness appears to be a recessive or practically a recessive character in *Oenothera*,[9] *Fragaria*,[7] in *Dianthus barbatus*,[8] in *Primula* and *Delphinium*,[2] in *Papaver*,[6] in *Pelargonium*,[1] *Chelidonium*[4] and *Ipomoea*.[10] In *Althaea*, *Meconopsis*, and *Dianthus caryophyllus* the hybrids of single and double flowered plants are intermediate and the progeny of the hybrids approximate a 1:2:1 ratio.[8]

Miss Saunders' studies on *Matthiola* showed that only two forms existed, the single and the fully double, and that no intermediate individuals appeared between these types. She further found that singleness is dominant but that curious genetical complications accompany its transmission. It is evident that the functional pollen and egg cells of some plants heterozygous for singleness are dissimilar, the pollen carrying doubleness only and the eggs being a mixture, some eggs carrying singleness and some doubleness. Frost[5] suggests that we may have here a selective sterility due to the factor for singleness or one closely linked with it possessing a lethal effect in the pollen, causing the functional pollen to be the double-carrying.

An exhaustive survey of the genetics of extra petals in other genera has not been attempted, but enough has been cited to make it obvious that there is no uniformity in the heredity of this common characteristic. The consider-

able amount of research already done does not enable us to prophesy what the relationship of singleness and doubleness is likely to be in the numerous cases awaiting investigation. The phlox work herein reported should make us hesitant about anticipating the type of behavior even when concerned merely with some uninvestigated variety within a species otherwise well known.

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9. Shull, G. H. 1928. The "Outside in" Oenothera flower, a new morphological type. *Proc. Nat. Acad.* 14:142-146.

10. Takezaki, Y. 1918. (Inheritance in the Japanese morning glory) Report *Jap. Assoc. Breeding Sci.* 2:7-11 (See *Bot. Abstrs.* 1, Entry 502).

11. Yasui, K. 1920. Genetical Studies in *Portulaca grandiflora*. *Bot. Mag. Tokyo* 34:55-65 (See *Bot. Abstr.* 7, Entry 943).


## Books Received

*BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the Journal will be reviewed in later numbers.*

Plant Hybridization Before Mendel, *by* H. F. Roberts, Professor of Botany, University of Manitoba. Pp. 374. 12 chapters. 48 plates. Price $4.00. Princeton University Press, Princeton, 1929.

From the bas-reliefs illustrating hand pollination of the date palm in Syria twenty-five centuries ago to the rediscovery of Mendel in 1900, is a fascinating story, all too little known.

Tree Crops, A Permanent Agriculture, *by* J. Russell Smith, Professor of Economic Geography, Columbia University. Pp. 333. Three parts, 24 chapters. 136 illustrations. Price, $6.00. Harcourt, Brace and Company, New York, 1929.

"Plan or Perish"—a plea for a new patriotism and, in hilly regions, at least a new agricultural technique.

Principles et Formules de l'Heredite Mendelienne, *by* L. Blaringhem, Professor of Science, University of Paris. Pp. 195. 11 chapters. Gauthier-Villars and Co, Paris, 1928.

A summary of Mendelian heredity, by a prominent French disciple of Mendel.

Modern Biology: A Review of the Principal Phenomena of Animal Life in Relation to Modern Concepts and Theories. *By* J. T. Cunningham, formerly Lecturer in Zoology at East London College, University of London. Pp. 244. 7 chapters. Price, $3.00. E. P. Dutton & Co., New York, 1929.

The author of *Hormones and Heredity* returns to the attack on the gene as an aid to evolution.

International Migrations: Volume 1, Statistics. Compiled on behalf of the International Labour Office, Geneva, with introduction and notes by Imre Ferenczi. Edited on behalf of the National Bureau of Economic Research, *by* Walter F. Wilcox. Pp. 1020. Many tables and graphs. Price, $10.00. National Bureau of Economic Research, Inc., New York, 1929.

An enormous mass of data on a vital subject, world-wide in its scope.

Crime, Degeneracy and Immigration: Their Interrelations and Interactions. *By* David A. Orebaugh, member of the Chicago Bar. Pp. 272. 17 chapters. Price, $3.00. Richard G. Badger, Boston, 1929.

Less facts and figures, but certainly more convictions (legal and intellectual) than the above.

# A TWO-HEADED SNAKE

Wm. H. Gates

*Department of Zoology, Louisiana State University*

THIS spring there was brought into the laboratory of the Zoology Department, Louisiana State University, a double-headed snake. The snake was the property of Mr. J. D. Morrison of Denham Springs, Louisiana.

Mr. Morrison stated that the snake was caught by two young boys, who not knowing its worth and like most boys, afraid of snakes, killed it and brought it to him. It was then put in a preservative and later brought to the laboratory.

**A DOUBLE-HEADED SNAKE**

**Figures 8 and 9**

A Siamese twinning condition restricted to the head and anterior neck region. The slight depression in the skull is due to partial drying while the snake was being photographed.

The snake is a young individual of the species of common grass snake, *Opheodrys aestivas*, measuring 92 mm. in length. It evidently was hatched this (1929) spring, and had grown normally, as it was about the size of the young of the grass snakes which are caught at this time of the year. The snake had apparently shown survival qualities, and was in good healthy condition, judging from its appearance after preservation.

As can be seen from the photographs, the redupli-

cation occurs only at the extreme anterior end, fusion of the two parts occurring in the region of the neck. Both heads are equal in size, and, as far as could be seen, the scales and sutures were identical, without the minor variations common to separate individuals.

The right head and neck were slightly twisted in the dorso-ventral plane, but this apparently had not militated against its development. At the point of apparent junction of the twin parts there was a marked flexure of the spine, which showed every indication of being a congenital deformity. It was impossible to straighten this out without breaking the vertebrae. The balance of the body appeared normal in every respect.

As the snake was a loan to the department, we did not feel justified in dissecting it to ascertain the internal arrangement. It is hoped that later an X-ray photograph may be obtained which will show, to some extent at least, the arrangement of the bony parts.

## Second Sex-Research Congress

THE Second International Congress for Sex Research will be held in the House of the British Medical Association, Tavistock Square, London, from August 3-9, 1930, under the presidency of Professor F. A. E. Crew, of Edinburg. Both in membership and in importance it is expected that this meeting will notably excel the First Congress, held in Berlin in October, 1926. Those who are interested are requested to write Professor Crew, The University, West Mains Road, Edinburgh.

The organization and purposes of the Congress can be fully served only by having all of the many aspects of sex research properly represented among the papers read at the London meeting. To American workers it is highly desirable that American investigations and investigators should be adequately represented at London—particularly since few from this country attended the First Congress.

An American sub-committee has been formed for the purpose of securing a maximum participation in the Congress by workers in this country. The members of this committee, representing biology, medicine, psychology, sociology and anthropology are: Dr. Oscar Riddle, chairman; Dr. A. A. Brill, Dr. Calvin P. Stone, Dr. William F. Ogburn, and Dr. Clark Wissler.

# EARLINESS IN $F_1$ BARLEY HYBRIDS

HARRY V. HARLAN, *Principal Agronomist,* and MARY L. MARTINI, *Assistant Botanist*

*Office of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture*

IN 1927 the writers of this paper made a large number of barley crosses. By sowing the parent varieties at Sacaton, Arizona, and later at Aberdeen, Idaho,* all but one of the possible combinations of 27 parents were made in a single season. These 27 parents were selected entirely for agronomic characters. At the time the hybrids were made there was no intention of pursuing any genetic study. The writers had become convinced that the study of genetics had advanced to the place where any simple observations on inheritance were hardly a contribution, even though both the characters and the ratios may have been previously unknown.

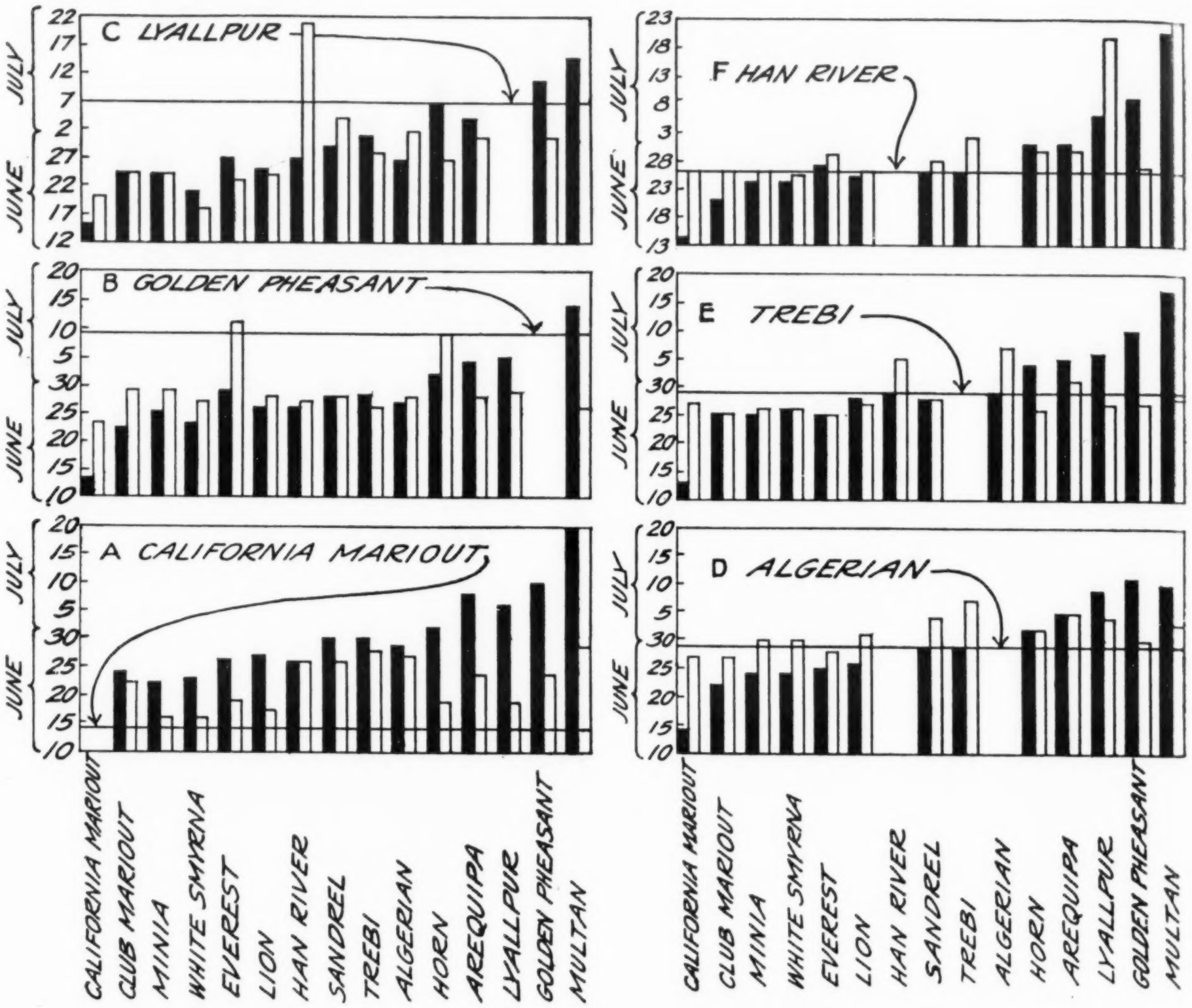
The $F_1$ generation of the 351 possible combinations between these 27 parents was grown in 1928 at Aberdeen, Idaho. As soon as the plants started to head it became apparent that no generalization as to the relationship of hybrids to parent in earliness was possible. As the season progressed the behavior of the hybrids was so interesting that it was felt that the results were sufficiently novel to warrant the making of some statement. The plants in the hybrid rows headed quite uniformly. In each case the hybrid was grown with the two parents adjacent to it, so that a direct comparison was possible. Variation in the relationship of hybrids to parents was expected. The expectations were much exceeded, however, when in a few combinations the hybrids headed as long as two weeks before or two weeks after the parental limits.

A summary of the 351 hybrids was made but, even when tabulated in its simplest form, the number of observations was too great to be visualized. Graphs are much clearer, but not more than 15 varieties can be advantageously presented on an ordinary page. Since the ends of this paper seem to be fully attained with this number, 15 varieties were chosen which showed the full range of variation.

In this article the date of emergence of the awns is used as the basis of comparison. All observations depicted in each graph are reduced to the average awn-emergence date of the constant parent, so that the date of emergence of the latter is represented as a straight line. In the graph (Figure 10-*A*) showing the hybrids in all of which California Mariout was the constant parent, this variety emerged on June 14 and a line is drawn across the graph at that point so that comparisons can be made more readily. Fourteen other varieties upon which California Mariout was crossed are named below. Above each name are two polygons. The first or black one shows the date of emergence of the awns of the non-Mariout parent grown in the row adjacent to the hybrid. The second or white polygon shows the corresponding date of the awn emergence of the hybrid itself. California Mariout showed awn emergence on June 14, Club Mariout on June 24, and the hybrid on June 22, a date between those of the two parents. California Mariout was the earliest variety grown and it will be noted that its hybrids are essentially intermediate. That is, none is so early as California Mariout and none later than the late parent.

After studying Figure 10-*A*, showing the relative dates of awn emergence in

*The cereal investigations at the Aberdeen (Idaho) Substation are conducted in cooperation with the Idaho Agricultural Experiment Station.




**RELATIVE EARLINESS OF PARENTS AND HYBRIDS**

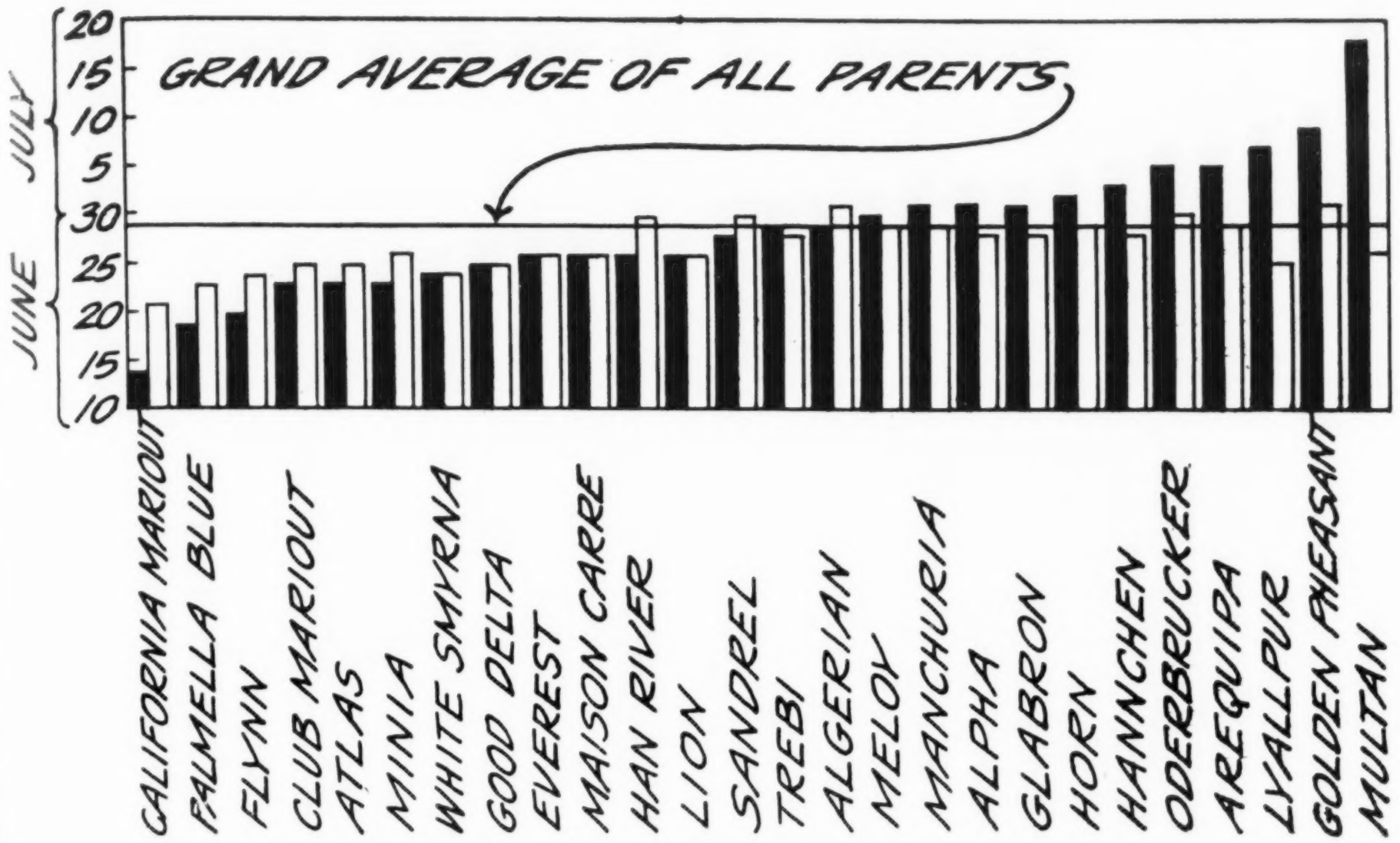
**Figure 10**

Relative earliness (date of awn emergence) of barley parents (black polygon) and of hybrids (white polygon) when grown at Aberdeen, Idaho, in 1928. The horizontal line shows the date of emergence of the constant parent named.

hybrids of California Mariout on 14 other varieties, it would be natural to assume that a second variety crossed on these same 14 sorts would show parallel variation. This, however, is far from being the case.

Similar crosses with Golden Pheasant are illustrated in Figure 10-*B*. Golden Pheasant was late at Aberdeen, the awns emerging on July 9. On the whole, its hybrids headed more nearly at the time of the earlier parent in each combination. The cross with Everest, however, was surprisingly late, especially as the average date of awn emergence of the 26 different Everest crosses was the same as that of Everest itself, and Everest was three days earlier than the average of the 27 parents. The progeny of the Everest cross on California Mariout gave no hint of this possibility. The Golden Pheasant × Multan cross was far outside the parental limits. The hybrid was 13 days earlier than the early parent and 18 days earlier than the later parent. This fact may not seem striking when written or graphed, but it means that in the field this row of plants was in full head days before the parents on either side had shown signs of producing flag leaves.

Even more striking results are shown in the graph of Lyallpur crosses in Figure 10-*C*. The Everest cross is back to normal. The Multan cross is nor-




**GRAND AVERAGES OF PARENTS AND HYBRIDS**

**Figure 11**

Average date of awn emergence for all rows of each of 26 parent barley varieties (black polygons) and of all rows of the hybrids of each variety with all of the others (white polygons). The horizontal line represents the grand average awn-emergence date for all of the rows of all of the parents, which was June 29.

mal. The Han River cross, however, which showed no abnormalities when California Mariout or Golden Pheasant was the other parent, is almost a winter barley here. It is later than the average of any of the 27 parents except Wisconsin Winter, which did not head. The awns emerged 14 days later than those of the Lyallpur parent and 24 days later than those of the Han River parent. In other words, the earlier spikes of Han River were practically ripe and those of Lyallpur well advanced when the hybrid headed. It will be noticed also that the Lyallpur × Horn hybrid was 10 days earlier than either parent. The Horn × Golden Pheasant hybrid was as late as the late parent (Figure 10*B*).

The observations recorded on date of awn emergence in hybrids of Algerian, Trebi, and Han River are illustrated by graphs in Figure 10. Neither the Algerian nor the Trebi series presents as wide variations as some of those already discussed, but they are interesting because the average date of heading of the two varieties is the same. A direct comparison is possible here. The hybrids of Algerian (Figure 10-*D*) are distinctly later than those of Trebi (Figure 10-*E*). Only three hybrid combinations are earlier than the Algerian parent, while seven are as late or later than the late parent. Although the behavior of the Trebi hybrids is broadly parallel, 11 of them are earlier than the Trebi parent, and only two are later than the late parent. One of these hybrids was with Han River, for which no corresponding record was secured in the case of Algerian. This cross was made too late to be grown with the others. The explanation of the difference between the two sets of hybrids lies in the probability that Algerian at Aberdeen is normally a later barley than Trebi. Just why the climatic conditions that made it develop as rapidly as Trebi in 1928 should not equally affect the same factor transmitted to

its progeny is not so readily explained.

The cross of Han River × Lyallpur has already been discussed. The observations recorded on crosses of Han River with 13 other varieties are shown in Figure 10-*F*. With the exception of the Lyallpur hybrid there is little that is striking in this graph. It is true that in no case is the hybrid earlier than the earliest parent, but that also was true with California Mariout and its hybrids. The Han River hybrids have a slight tendency to be late. The average awn-emergence date for 25 combinations was 4 days later than that of the Han River parent.

A summary of the results with 26 varieties is presented in Figure 11. The Wisconsin Winter combinations are not included because this variety itself did not head. In this graph the base line of comparison is the grand average awn-emergence date for all parent rows, which was June 29. Above the name of each variety are two polygons. The first represents the average emergence date of all rows of that particular parent and the second the average emergence date of the hybrids of that variety on the 25 other sorts. It will be noted that the average of the hybrids is more or less intermediate until the average of parents coincides with the grand average of all parents. Trebi stands at this point. There are 12 varieties as late as or later than Trebi, but the curve of the hybrids flattens off and finally falls below the average of all parents. Indeed, the grand average awn-emergence date of all hybrids is more than 2 days less than the average of all parents. Most of this difference is accounted for by the relationship of the last three varieties in the graph to their various hybrids.

The earliness of many hybrid combinations of the later varieties indicates that these varieties are not late because they want to be, but that, on the contrary, they contain many factors of earliness. This is corroborated by the fact that both Lyallpur and Multan are early when grown at Sacaton, Arizona. While presenting some winter characteristics at Aberdeen, they do not behave at all like Wisconsin Winter, which is late at Sacaton. Incidentally, many of the Wisconsin Winter hybrids are as early as the early parent at Aberdeen.

It is realized that we are working with an involved length-of-day factor and one that is delicately balanced. It is probably complicated by several other factors, the nature of which is not now apparent. In any case, it is certain that had the material been grown at another place, or the seeds sown on another date, the awn-emergence dates would have been far different.

## Sex-Determination for the Layman

WHY WE ARE MEN AND WOMEN, by A. L. BENEDICT, A. M., M. D., F. A. C. P., Major, Med. Res., U. S. A. Pp. 270, 19 chapters, 6 figures. Price $2.50, net. Allen Ross and Company, New York. 1929.

There is nothing particularly unusual about this book unless it is the bibliography, which includes citations plucked from such widely separated sources as the *Mississippi Times,* September 23, 1853, and some of the best scientific books and journals of 1929. The subject matter is presented as a survey of the factors determining sex, written in a style which can be understood by the general reader. The author accepts the "almost unquestionable" genetic evidence on the mechanism of sex determination but has made one bad slip in the discussion of the sex chromosomes in mammals and in birds.

Although the book adds little to our knowledge of the question of why we are men and women, it does bring together many weird theories, so that the layman can learn something about them with a minimum of effort, and be better able to evaluate them at their true worth, when the encounters them elsewhere. *H. C. M.*

# HEREDITY OF THE TRAIL BARKING PROPENSITY IN DOGS

LEON F. WHITNEY
*New Haven, Conn.*

**SEGREGATION OF TRAIL BARKING AND HAIR LENGTH**

**Figure 12**

The grandfather and grandmother of these two dogs were a hound and a collie. The father and mother were brother and sister of sable color and short hair. The open trailing characteristic segregated with the long hair in the case of these puppies and the still trailing propensity is combined with the short hair. In other words, the dog which looks like the collie is an open trailer while the dog which looks like a hound is a still trailer.

IN several instances* I have written about the fact that when a dog representing a breed which while pursuing game, gives tongue on the trail, is mated with a dog representing a breed which trails mutely, the progeny gives tongue on the trail. A large number of such instances have been observed where I have had an excellent opportunity to make these observations when hunting raccoon, for which both sorts of dogs are used. In no case have I known of an instance in which a purebred open trailer mated with a still trailer has produced progeny that are anything but open trailers. This propensity has nothing to do with training. It is exhibited very early in the life of the dog and generally is observed the first time the dog follows an animal track of his own accord.

In my experimental crosses, which

**American Kennel Gazette* 1926.
The Builders of America 1927.

have been made for several purposes, this fact has again and again been noted. The following examples will suffice:

| *Open trailers* | | *Mute trailers* |
|---|---|---|
| 1. Bloodhound | × | Airedale |
| 2. Foxhound | × | Collie |
| 3. Springer Spaniel | × | English Setter |
| 4. Bloodhound | × | Norwegian |
| 5. Foxhound | × | Norwegian |
| 6. Beagle | × | Cocker Spaniel |
| 7. Dachshund | × | Fox Terrier |
| 8. Foxhound | × | Airedale |

The $F_1$ progeny of these crosses produced only open trailing pups.

In no instance has a pair of purebred hounds been known to produce offspring which would not bay on the trail.

In no instance has a pair of purebred mute trailing dogs been known to produce open trailers. This is the universal expectancy of dog breeders.

It is interesting to note that in all cases observed where a hound with the characteristic round full note to his voice has been mated with a still trailer, the pups have all had the type of voice of the still trailer; that is, a yap instead of a drawl. For example, a collie mated with a hound produces offspring which have the typical yap of the collie. The drawl of the hound's voice is apparently recessive.

Only one pair of such $F_1$ dogs has been mated and the results were interesting. An old-fashioned tan shepherd dog so common to the country, was mated to a pure hound. The pups were all open trailers. Two of the pups were mated. They were yellowish colored, with hair almost as short but slightly longer than the hound's. Two of the pups from this mating were retained. One was long-haired and tan and the other was short-haired and black and tan. The picture shows their appearance. It might have been expected that the dog which looked more like the hound grandparent would have been an open trailer, while the pup which looked like the shepherd grandparent would have been a still trailer. Actually this expectation was not realized. The dog with the long hair is an open trailer; the one with the short hair, black and tan in color, is a still trailer. The segregation is definite.

## A New Technique of Parentage Determination

IN view of the inconclusive nature of parentage determination through blood grouping and other characters, a new tenchnique reported in the November 1 "Berlin Letter" of the *Journal of the Americal Medical Association* is likely to attract much attention. If the results are substantiated they should be of great practical importance and of much interest to geneticists. The possibility that there is a specific reaction between the serum of every offspring and either parent would seem on theoretical grounds to be highly improbable. It is claimed that the technique involved produces reactions that can be evaluated by objective photometric means, so that independent verification should be easy. If this is obtained the explanation of the phenomenon will present a fascinating problem because it will imply a mechanism capable of producing literally millions of specific reactions. One cannot but suspect that if the existence of a universal parent-offspring serum reaction proves to be a fact it will also be found that the reaction occurs between other sera not necessarily related. The extreme unlikelihood that the reaction will prove to be specific in every case will warrant skepticism until confirmation has been abundantly obtained.

Since the announcement is calculated to arouse wide interest we are quoting from it at length.

In view of the extraordinary importance of the problem of the serologic determination of parental origin for both science and practice (to mention only the theory of hereditary transmission, alimentation processes, and the like), Professor Zangemeister, director of the Konigsberg Universitats-Frauen-Klinik, has long been endeavoring to discover a method of procedure that would permit him

to demonstrate the specific individual qualities of the blood serum, which he postulated. According to a report contained in the *Deutsche medizinische Wochenschrift* on the researches carried out by Zangemeister with the cooperation of Konigsberg physicists, it proved possible, with the Zeiss graduated photometer, to demonstrate that a mixture of the blood serum of the new-born with that of either parent gives a characteristic change of color when viewed in Tyndall light. By Tyndall light is meant the light that is reflected or dispersed by the smallest particles that are contained in a substance, through which the otherwise invisible particles are made accessible to the perception, corresponding to the frequent observation that dust particles can be made visible in a darkened room by allowing a ray of light (for example, a ray of sunlight) to enter. This Tyndall light undergoes no change, or at most only a slight change, when the blood serums of unrelated persons are mixed, whereas it decreases considerably within a few hours if the serum of one of the parents is mixed with that of the offspring. Recently, Zangemeister is said to have demonstrated that the same reaction occurs in older offspring (up to age 30) when their blood serum is mixed with that of either parent, as compared with the mixture of serums of unrelated persons.

In order to eliminate all subjective influences from the experiments with the photometer, the same experiments were repeated and this time the human eye was replaced by a cell sensitive to light. Here, too, the same phenomenon was demonstrated. In further experiments, an attempt was made to establish and elucidate the photometric process by ultramicroscopic researches in a dark field. In a dark field, the smallest particles become visible only through the light dispersed by them, whereas in a penetrating light they remain invisible. Serums and serum mixtures were observed in the dark field under strong illumination, while fresh and also after certain intervals, and the pictures were preserved by means of instantaneous photographs taken of them. In this connection, it was observed that the visible protein particles developing when the serum of the offspring was mixed with that of the parent become much fewer after half an hour. The finer particles are replaced by coarser formations, doubtless owing to the clumping of the protein particles. In the case of mixtures of serums of unrelated persons, this phenomenon was always absent. The process developed usually so rapidly that a few minutes after the mixture characteristic changes were observable. As it was possible to separate the blood serum from the blood corpuscles immediately after the blood was taken, the diagnosis as to origin could commonly be reached within an hour after taking the blood. This mode of examination offers, in addition, the advantage that, in contrast with the photometer, only very small quantities of blood are required. The photometer, on the other hand, makes it possible to observe the process not only qualitatively but quantitatively from the standpoint of time. The result will probably be that both methods of procedure (ultramicroscope and photometer) will be employed in establishing the parental origin of a subject. From the ultramicroscopic instantaneous photographs, even the novice can establish the parental origin at once.

Partly for theoretical reasons and partly in view of the importance of the method of investigation for the theory of origin and the theory of hereditary transmission, and also for animal husbandry, similar researches were carried out in animals. In a number of animal species analogous changes were observed. In the animal experiments, some difficulties were encountered in endeavoring to keep the serums and serum mixtures optically constant. The reliability of the method of investigation is already relatively high.

## What Is Life?

AT the South Africa meeting of the British Association for the Advancement of Science, held last summer, one of the important features was a conference on the Nature of Life. This was contributed to by many distinguished leaders in fields bordering on this complicated subject. In *Nature* for September 14, 1929, a summary of the symposium was presented in the leading editorial, from which the following paragraphs are reprinted:

Modern discussions of this perennial question, What is Life? have shown in varying degrees a recognition of the commonplace that an answer lies in a fuller knowledge of living creatures. No amount of verbal dexterity or even profound reflection over the concept of "life" floating in detachment will get us much "forrarder" unless we are at the same time deepening our acquaintance with organisms from microbes to men, and trying to see life whole, not as a biochemical witch-pot merely, but as the activity of individualities that develop, grow, and reproduce, that struggle, vary, and evolve. If we are to answer the question, What is Man? or What is Personality? we must deepen

our knowledge of men and of personalities, and of Shakespeare and Newton as well as of Bushmen. So to avoid false simplicity in our answer to the question, What is Life? we must seek a comprehensive, all-round, and intimate view of organisms, taking account of intelligent apes as well as of dimly purposive amebae, and of psycho-biosis as well as of bio-psychosis. We cannot make sense of any kind of life without recognizing the importance of fermentation, but we cannot make sense of the life of higher animals apart from feeling, intelligence, and some sort of purpose; and the continuity of organisms makes it probable that the dim analogues of these psychical qualities are present throughout.

The extreme behaviourists or bio-mechanists, perhaps represented at the conference, to judge from the reports, by Prof. L. T. Hogben, will of course refuse to take account of any process which does not admit of physico-chemical analysis and description—a position that does not work out well in our daily life and conversation, where we have to allow at every turn for intelligent or even rational purpose—but even these extremists will agree that an understanding of life is most likely to follow a widening of our study of actual organisms.

(2) No one has as yet succeeded in redescribing in terms of anything else a fair and intact sample of that distinctive kind of activity that we call life; and it is *possible* that the nature of life lies outside the realm of the knowable, as the noncommittal Prof. Barger suggested at the conference. Such being our ignorance, we advance to a second proposition, that it is always useful to return to the bedrock of facts and seek to envisage *living*, if we cannot understand *life*. Living always means that living creatures act on their surroundings and are acted on by them. Taking the first letters of the three biological co-ordinates—organisms, function, and environment—Prof. Patrick Geddes suggests as a descriptive definition of living—$O \rightarrow f \rightarrow e$: $E \rightarrow f \rightarrow o$. In condensed form, living is an ever-changing ratio between *Ofe* and *Efo*, or *Ofe/Efo*, the numerator aspect being prominent at one time, the denominator aspect at another. This is obviously no definition of "life", since the words organism and function imply the whole mystery; yet it is a very useful positivistic conception; and it may save us from the fallacy of trying to define organism apart from environment. Whatever be the true inwardness of life, the facts that we study are $O \rightarrow f \rightarrow e : E \rightarrow f \rightarrow o$.

(3) It is always useful to get below superficial differences to fundamental resemblances. Thus it was a notable step when Huxley united birds and reptiles as Sauropsida, and a still greater when Claude Bernard justified Linné's term Organisata, by showing in detail the phenomena common to the life of plants and animals. On the other hand, there is danger in satisfynig our desire for unity, or for continuity, by sticking the same label on things or processes which remain very different. Thus the word "evolution" is used as a label for a variety of genetic processes which have not very much in common save that they are modes of becoming. * * *

No one stands for continuity more firmly than General Smuts, yet he insists that "matter", "life", and "mind" are disparate orders of fact. This does not mean that they are separated by hard and fast boundaries, for organisms are whirlpools of matter and energy, and the members of a human society are rational mammals, and mind is clearly emergent in many an animal. Yet if anything is gained, something is lost by speaking of the life of crystals, or the organism of the atom, or the fellowship of molecules, or the society of cells in the body. Organism, for example, is a clear-cut well-established term, and it should be kept for genuine organisms, not blunted by application to atoms on one hand or human societies on the other.* * *

(7) Finally, it seems to us that the most tenable position is what may be called "methodological vitalism". Mechanistic descriptions are indispensable, and we owe to the mechanists in particular a deeper understanding of the environmental factor in living ($E \rightarrow f \rightarrow o$). But at its best, at present, mechanistic formulation is far from giving us an adequate account of the life of organisms. Vitalistic descriptions are also indispensable, for whether the organism has an entelechy at heart, or whether it is one of a long series of "syntheses", or "integrates", or "wholes", its life cannot be adequately described in terms of mechanism. The vitalists have done good service in emphasizing the organismal factor in living ($O \rightarrow f \rightarrow e$), and also, of course, the functioning factor, for life is *par excellence* activity, as Wilden Carr so well insists. But the scientific inquirer is not fond of "principles" or "entelechies", and he dreads "vital forces" in disguise; so what can he do but maintain not a positive but a methodological vitalism? That is to say: as things are at present, the mechanistic formulation of organisms and their functionings in their environments does not answer the distinctively biological questions. Biology has concepts of its own at present irreducible to chemistry and physics: the living creature is a historic being enregistering its experience; it is a purposive individuality that gets things done; it grows, multiplies, develops, struggles, varies, and evolves; it often has a mind of its own.

**"TENUOUS" PLANTS AND NORMAL**
**Figure 13**

Showing the relative plant development of normal kafir plants (left) and grass-like plants (right). The shorter normal plant is four feet tall. The seeds which produced these plants were from a single head.

# TENUOUS KAFIR PLANTS

JOHN B. SIEGLINGER
*Bureau of Plant Industry*

SEVERAL very slender, grass-like plants were observed in a singie head-row of $F_5$-generation plants from a cross between Sunrise kafir and Red kafir at Woodward, Oklahoma, in 1926. On examination, it was found that the plants had produced practically no secondary or coronal roots but had made all of their development from single seminal roots. Figure 14 shows the roots of each of two normal and two grass-like plants. Normal sorghum plants produce only a single seminal root, thus differing from other cereals, which produce three or more. The relative plant development of the normal and the tenuous plants is shown in Figure 13. The tenuous plants had been produced from seeds which appeared similar to seed that produced normal plants. Most of the slender plants were hoed out when the field was weeded, in 1926, but not one of those which escaped destruction produced seed. Most of the tenuous plants did not head and the heads which appeared produced only rudimentary glumes and ovaries and no anthers or stigmas.

In 1927, the remainder of the seeds from the head which had produced the defective plants was sown and again the grass-like plants occurred in considerable numbers. Other rows from sister heads were grown, but produced normal plants only. Again no pollen or seed was produced by the defective plants, so a number of heads from normal plants in that row were saved for seed.

Twelve head-rows were seeded in 1928 from selected open-pollinated heads, but only one of these produced tenuous plants. A count was made when the plants in this row were about 8 inches tall. Of a total of 597 plants, 121 were grass-like and deficient in

**ROOT-SYSTEMS OF KAFIR PLANTS**

**Figure 14**

Showing comparative root system of normal kafir plants (left) and grass-like kafir plants (right). "Tenuous" appears to be a simple Mendelian character, recessive to normal.

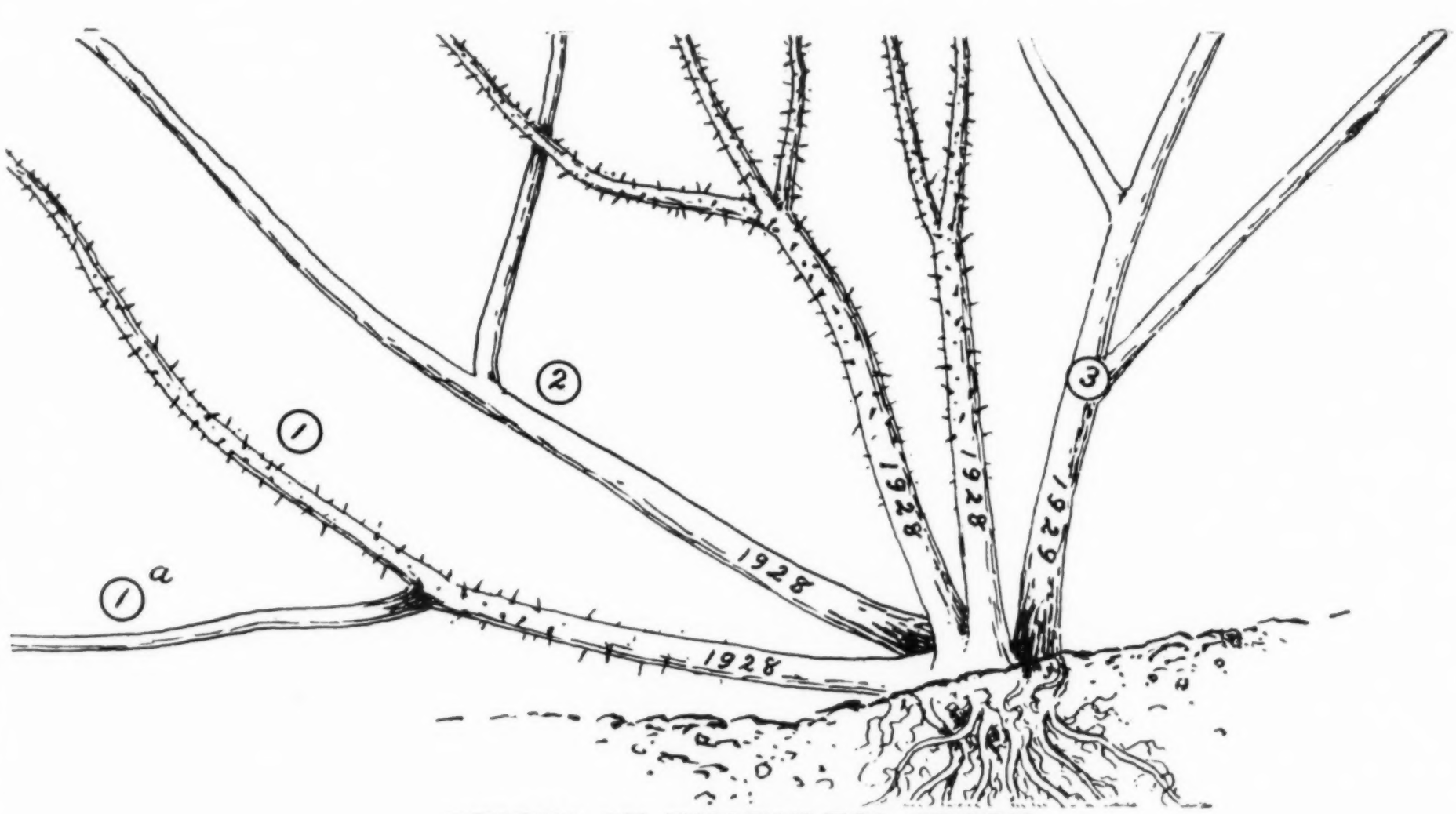
secondary roots, and 476 were normal.

This is a deviation of $28 \pm 7.1$ plants from a theoretical 3 to 1 ratio, which is somewhat greater than would be expected from random sampling. The possibility that some of the seeds may have been cross-pollinated in 1927 and that some of the defective plants might have died before the counts were made in 1928 would tend to increase the proportion of normal plants so that a single-factor explanation seems plausible.

Judging from the numbers obtained in 1928 there exists a single recessive factor which in its homozygous condition prevents the development of coronal roots and the thickening of stems and leaves. This reduces the development of the plants to such an extent that they do not fruit. This deficiency, while of no economic importance, seems worthy of record as of possible interest to plant breeders and physiologists.

# THORNLESS SPORTS OF THE YOUNG DEWBERRY

GEO. M. DARROW
*Bureau of Plant Industry, U. S. Dept. of Agriculture*




**ORIGIN OF THORNLESS SPORT**
**Figure 15**

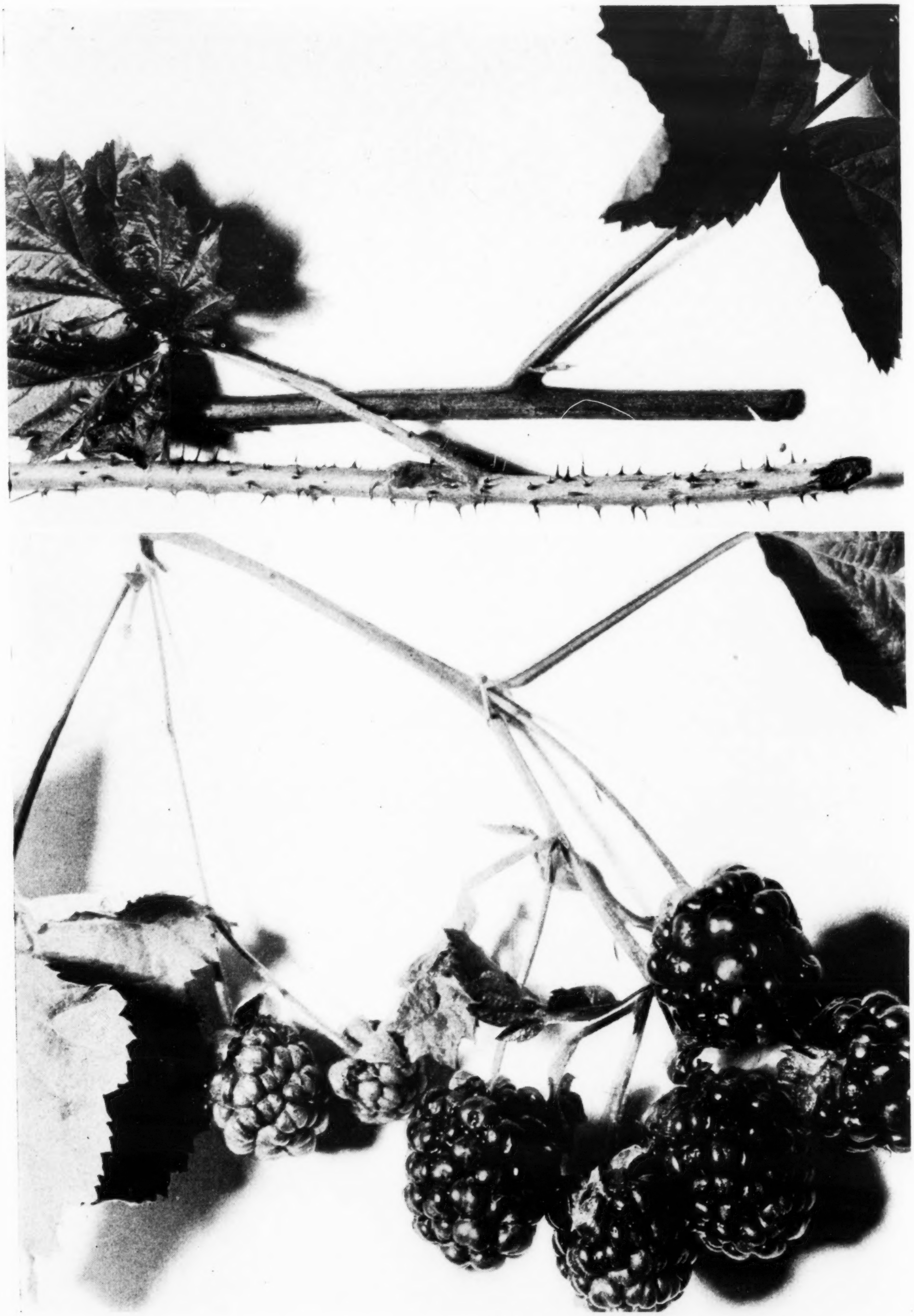
Diagramatic drawing of the original plant from which the productive thornless sport was propagated. Canes 1 and 2 appeared in 1928 and cane 3 in 1929.

THORNLESS blackberries and dewberries have a strong appeal to those who come in contact in any way with the plants which bear these fruits. Notes summarizing the information on thornless blackberries were published in this Journal in 1928.* Later in the summer of the same year the writer was visited by E. L. Pollard, who told of thornless sports of the Young dewberry on his place in California. On his return to California, Mr. Pollard found and tested six different thornless sports. These he watched in 1929—all but one of the six proved to be worthless, showing more or less wrinkled leaves, pale or yellowish foliage, too many undeveloped fruits, or blossoms that failed to mature any berries.

The one exception was apparently equal in every way to the original Young and perhaps superior in having more berries to the cluster (Figure 16). All propagations of this sort were thornless. The drawing of the original plant (Figure 15) indicates that the tissue on one side of it sported to thornless and from such tissue cane (2) appeared. Cane (1) apparently came from the boundary of the thornless and thorny tissue and a thornless branch (1a) was produced from it. In 1929 an additional thornless cane (3) was produced by the same plant.

Mr. Pollard has written that a neighbor has a plant of the Young which produced a single thornless cane from a bud which appeared about two inches above the ground. This cane also pro-

*Darrow, Geo. M. 1928. Notes on Thornless Blackberries, *Jour. Heredity*, 19:139-142.



**A PRODUCTIVE AND THORNLESS DEWBERRY**

**Figure 16**

Above, thorny and thornless canes of the Young; below, a fruit cluster of the thornless sport.

duced normal berries. Still other thornless sports of the Young have been reported from Alabama.

The success of Mr. Pollard in finding a productive thornless sport of the Young calls attention to the desirability of finding similar sports of the standard blackberries of each section of the country. These are especially to be desired of the Oregon Evergreen and of the Himalaya, which are propagated by tips as is the Young; and of the Eldorado, Early Harvest and other erect sorts which are propagated by suckers and root cuttings. Thornlessness in the dewberry is advantageous, not only in lowering the cost of training and in lessening the discomfort of picking, but also in reducing the very serious injury to the canes themselves caused by the thorns. Similar advantages might be obtained with thornless Oregon Evergreen and Himalay blackberries.

## The Characteristics of Wool

WOLLKUNDE, by G. FRÖLICH, W. SPÖTTEL, E. TANZER. Bildung und Eigenschaften der Wolle. (Wool, its formation and characteristics). Technologie der Textilfasern edited by R. O. Herzog, vol. 8, part I, Julius Springer, Berlin, 1929. 2 plates, 172 text figures, 428 pages. Cloth 54 marks.

This book probably is the only monograph available at present in any language which gives a complete survey of our knowledge of all the different characteristics of wool. The authors give a detailed and clear description of morphology and histology of skin and hair which in large part is based upon their own investigations in different breeds of sheep. Large chapters are devoted to the fineness of wool, its different aspects and the secondary factors influencing it; to the uniformity of wool; to its physical and chemical traits; to the fleece and its constituents, and finally to the wools of different breeds of sheep. The book is full of valuable information and should be of great assistance to all interested in breeding for the genetic analysis of certain characteristics of wool. The illustrations are unusually good.

*W. L.*

**THE "TOTEM-POLE" ROSE**

**Figure 17**

Pillars of roses ten feet high may be produced by the use of an exceptionally vigorous new stock, which was found among a group of seedlings of the blue rose, Veilchenblau. It produces canes as much as three inches in diameter, and of proportionate length, making it a true giant among roses.

# A NEW ROSE STOCK

D. W. COOLIDGE
*Coolidge Rare Plant Gardens, Pasadena, Calif.*

DURING the year 1918, I spent considerable time around my grounds investigating and gathering rose slips with the intention of seeing what unaided Nature had done in the way of making some new roses. Hundreds of seeds were stratified in sand, and, after a provokingly long wait, a few of them began to sprout. I had growing in close proximity, in my nursery, two strong plants—one of Veilchenblau (the so-called Blue Rose) and one Tausendschoen (Thousand Beauties). I recall picking seeds from both, wondering if Dame Nature might give me a bluer rose or some other unusual color. When the seeds began to sprout I noted one little fellow determined to go ahead of all the others. This I soon recognized by the foliage to be the progeny of Veilchenblau. These seedlings were all carefully transplanted, and, as generally happens with seedlings, no world-beaters in the rose line were noted save the one blue rose seedling which grew so lustily as to command immediate attention.

Then came the two years' wait for a flower, which matured in the spring of 1921. I am sure there are no words that could picture my disappointment when I viewed the first opening bud—a muddy, purplish, magenta color. I did not give it any further consideration until when moving our nursery in 1924, I rediscovered the seedling growing in an obscure corner of the nursery and the fact was then forcibly impressed upon me that for rose growth I had never seen anything to approach it—the main stalk was fully three inches in diameter, and, well, I will not pretend to state how long the canes were. In the fall and winter of 1924-25 I made many cuttings—recognizing that for vigorous, smooth, thornless and straight stems it had, within my knowledge, no equal as a growing-on stock. Up to that time I had not fully realized its possibilities. In watching an individual plant, I observed the bud beginning to break in five days, and in twenty-eight days I had a full-blown flower.

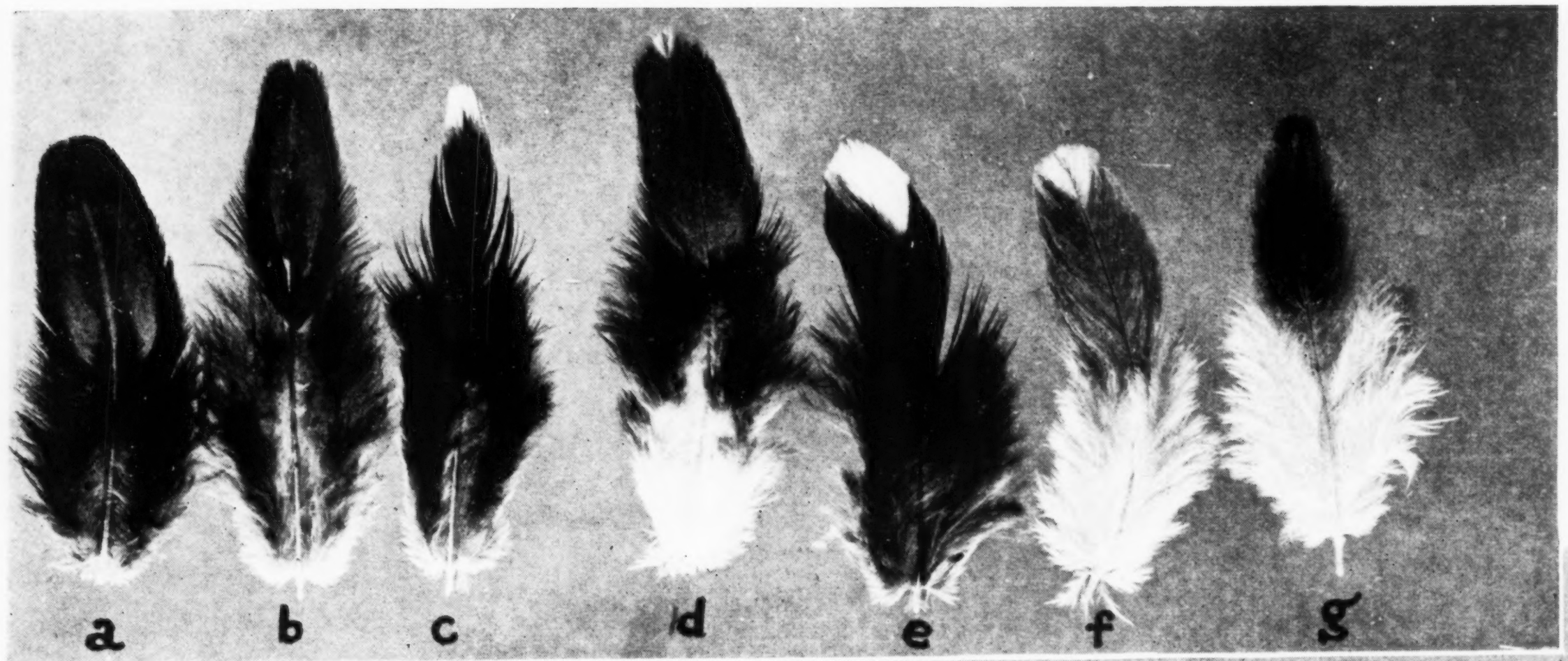
It is being tested as a growing-on stock under glass, and, if it proves proportionately as vigorous indoors as out, a saving of six months' time in maturing a crop of flowers should represent a considerable amount to large growers.

We have appropirately named this new rose stock the "I. X. L." It is unequaled for vigor and rapidity of growth and is practically thornless, which makes it easy and comfortable to handle. It has not shown any tendency to mildew nor any of the diseases prevalent amongst roses. It produces a longer stem and a larger and more intensely colored bloom. It is almost an evergreen, which also gives it a distinctly ornamental value. It does not sucker from the root and the occasional shoots coming from the base of the plant can be easily removed.

We are now using it exclusively for bush and tree roses and the results have exceeded our expectations. A new style rose tree is made possible by the use of this stock, which we have named the "Totem Pole." Buds were inserted about six inches apart from the ground up and all grew with equal vigor. By using canes two years old, it is possible to produce a pillar of roses up to ten feet high. One can readily imagine the striking color effect obtainable by budding either wth a single variety or with several varieties in appropriate combinations.

The "Totem Poles" lend themselves to a wide range of use in landscaping and, with the proper blending of colors, produce a very artistic effect, either as single specimens or as a screen bordering a lawn or driveway.

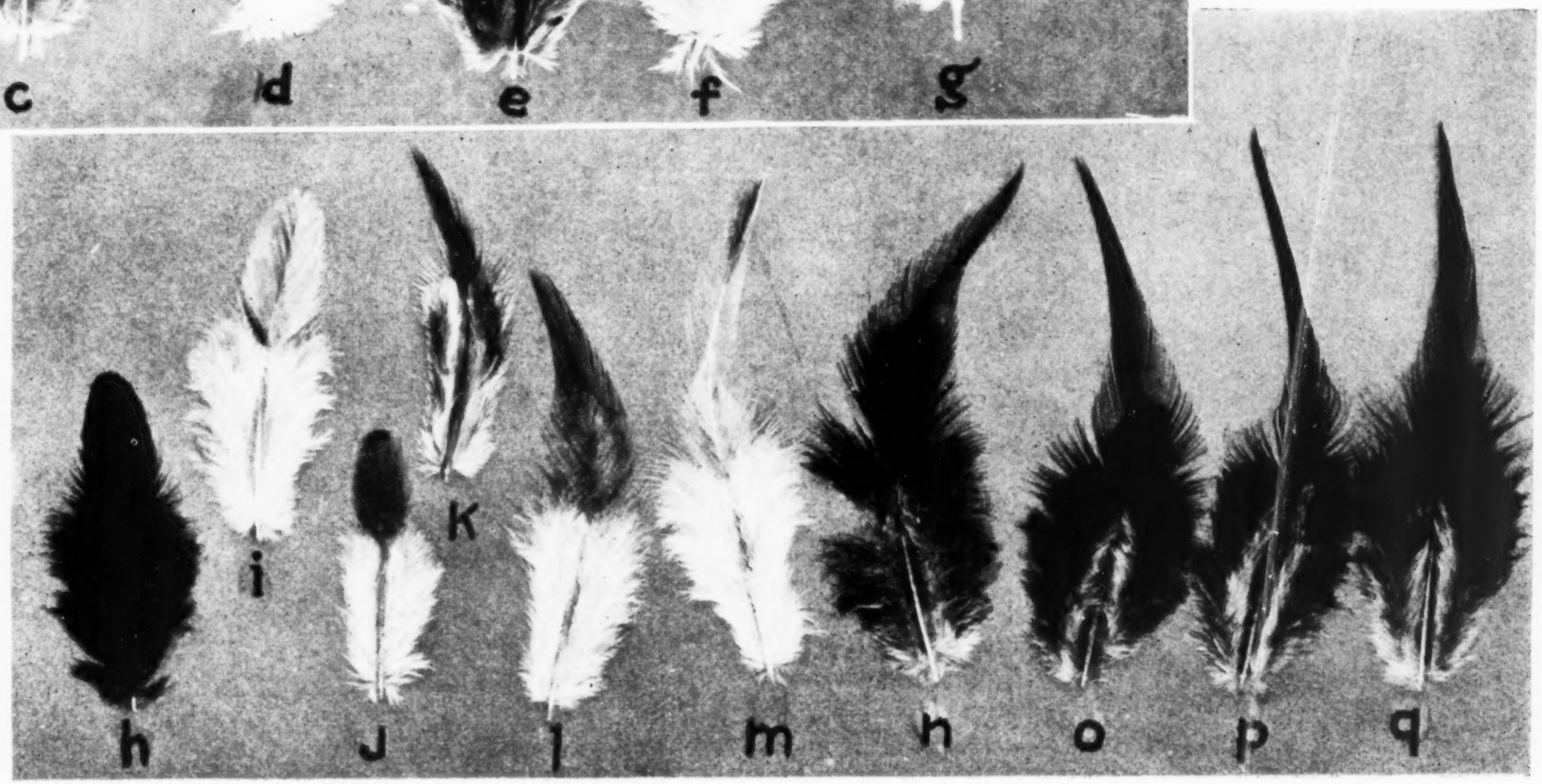
The "I. X. L." has been investigated by some of the most notable horticulturists and rose specialists in America, and they have pronounced it one of the outstanding innovations in the history of rose culture




## HYBRID FEATHERS OF DIFFERENT PATTERNS

**Figure 18**

*a* and *b* the two markings in type 3; *c* the coloring of type *2* but with a white tip induced by thyroxin injections; *d*, *e*, and *f*, normal white spangling in three different combinations; *g*, a yellow feather with a black tip (type 5).




At the left are shown feathers plucked from the backs of a number of different specimens to show male, female, and intermediate forms. The first, *h*, is from a hen-feathered black cock; *i*, was produced by skin of a cock with intermediate plumage grafted on a hen; *j*, is from skin of a hen grafted on a cock; *k* and *l* are from cocks with intermediate plumage; *m* from skin of a light cock grafted on a dark one; *n* from skin of a hen on a cock-feathered male; *o* from a genetically cock-feathered capon; *p* from a genetically hen-feathered capon; and *q* from a piece of female skin grafted on the preceding.

# BANTAM GENETICS

## Distribution of Traits in a Sebright-Mille Fleur Cross

C. H. DANFORTH
*Department of Anatomy, Stanford University*

DURING the past few years a flock of Bantam fowls has been maintained at this laboratory chiefly for use in endocrine and skin-transplantation experiments, but incidentally serving for genetic studies. The flock originated from two Golden Sebright hens and a Mille-Fleur cock of the non-bearded variety. From this mating something over two hundred descendents have been obtained in the course of five or six generations. After the second generation matings were more or less haphazard, or so planned as to give offspring differing among themselves in as many respects as possible. This procedure is not calculated to furnish the most satisfactory data on genetics, but a number of results which have appeared more or less as by-products may be of interest. Notes on the genetics of color, hen-feathering in the male, comb form, leg feathering, brachdyctyly, vulture hock, and size will be presented. The Bantam was found to afford rather favorable material for genetic work because of its small size, ease of handling and rapidity of reproduction, two generations being obtainable in a year.

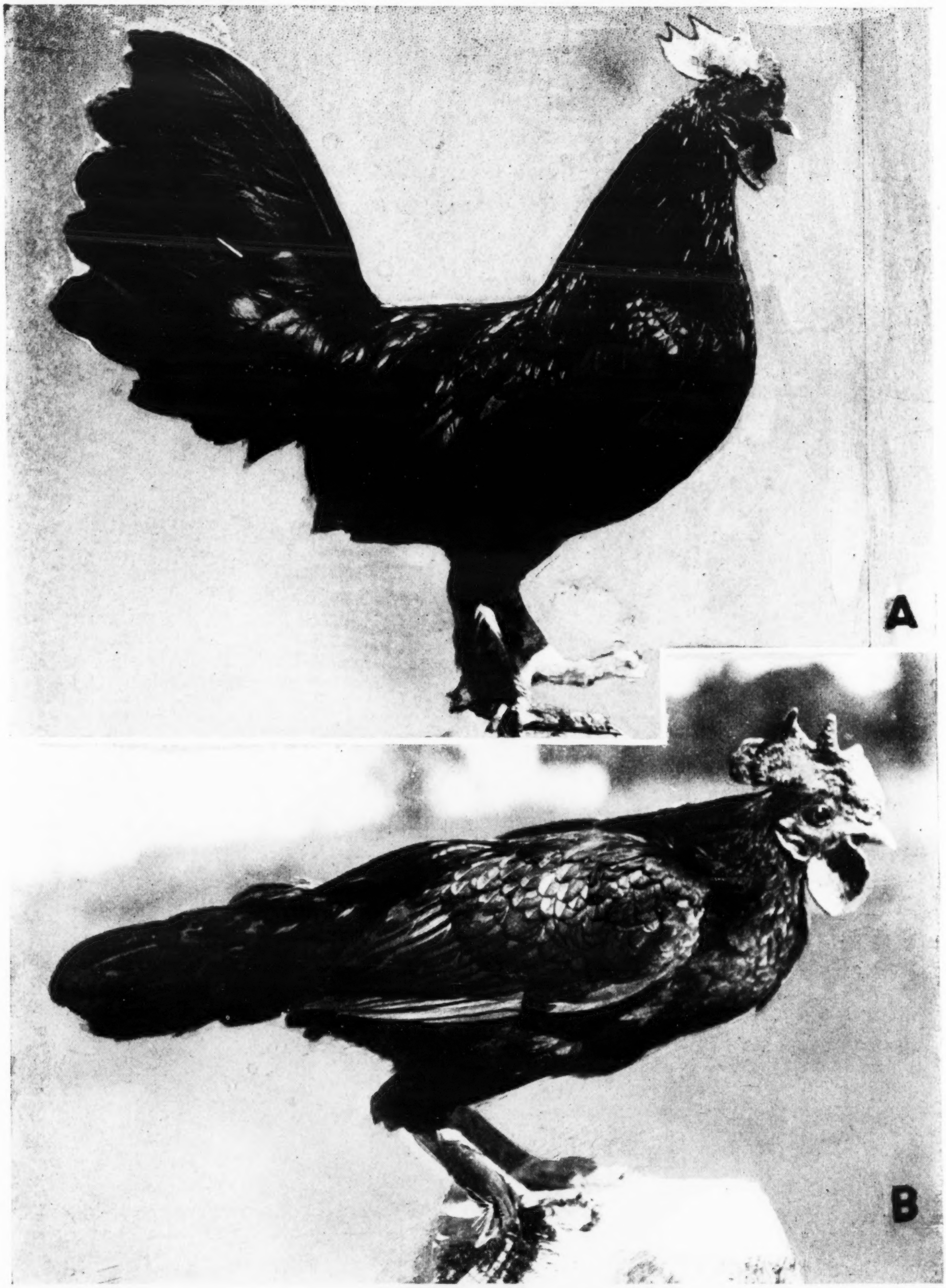
### Color

The standard Golden Sebright[1] is characterized by similarity of color and markings in both sexes. In this breed the expanded portion of each feather is of a deep golden yellow surrounded by a narrow black border. The under color is dark slate. In the Mille Fleur there are plumage differences associated with sex. The female is a rich golden buff with each contour feather tipped by a white spot bordered proximally by a V-shaped black zone. The tail feathers are black tipped with white, and there is also a considerable amount of black in the primaries and secondaries of the wing. In the male the ground color is deeper, amounting to red in the cocky feathers of the neck, saddle and wings. Each of these long cock-type feathers has in addition to its terminal spangle a black shaft, giving the effect of lacing. The under color of the feathers in both sexes is slate toward the surface and pale salmon toward the base.

In the $F_1$ generation there were seven females and three males all very uniform in appearance. The markings were essentially those of a Sebright, except that the amount of black was greatly increased. There was no trace of white. In the contour feathers the black border was wide and frequently supplemented by additional black within the central gold field (Figure 18, *a*, *b*). Tail and wing feathers were mossy (Figure 19*B*, and Figure 20*F*) and the hackle somewhat laced, indicating that dominance of the Sebright pattern is not the same in all parts of the body.

In subsequent generations there were, in addition to white spangling (Figure 18 *d-f*) which occurred in connection with all other patterns, six types of coloration in the female form of plumage. These were: (1) pure black (Figure 18 *h*), (2) black with some brown shafted feathers and feathers with small yellow centers, (3) the $F_1$ type, (4) yellow with black terminal markings which sometimes extend in crescentic form down the sides of the feathers, (5) yellow with black tip on many of the feathers (Figures 18 *g* and *j*) and (6) yellow with no black except a slight amount in hackle primaries and tail (Figure 21 *J*). There were very few specimens which did not fit clearly into one or

grafted on the preceding.




**TWO MALES FROM THE $F_1$ GENERATION**

**Figure 19**

They were originally practically identical in plumage, but about two years previously the greater part of the testicular material had been removed from *A*. The $F_1$ males were hen-feathered, a more cocky type of feathering was assumed after castration.

another of these groups. The undercolor in some individuals reproduced that of the Sebright, in others that of the Mille Fleur. It also appeared as black, white, and salmon (Figure 18).

No difficulty was experienced in extracting black (type 1) and yellow (type 6) strains from the descendants of the first generation. But when these were crossed, neither proved to be dominant, nor did they reproduce the $F_1$ type. The young, instead, were of grade 2. From this it would appear that blacks, yellows and grade 2 individuals have lost a part of the $F_1$ complex, which apparently includes a dominant gene for black lacing. When heterozygous this gene is almost completely dominant in the short feather of the wing, capable of making its presence evident in feathers of the breast and back, and almost completely recessive in tail feathers and primaries. In the downy stage, types 2 and 3 were not differentiated, both being black with brown eye-rings, a brownish wash on the wings and under parts, and gray, white, or buffy throats. Chicks of type 1 are pure black with white throats.

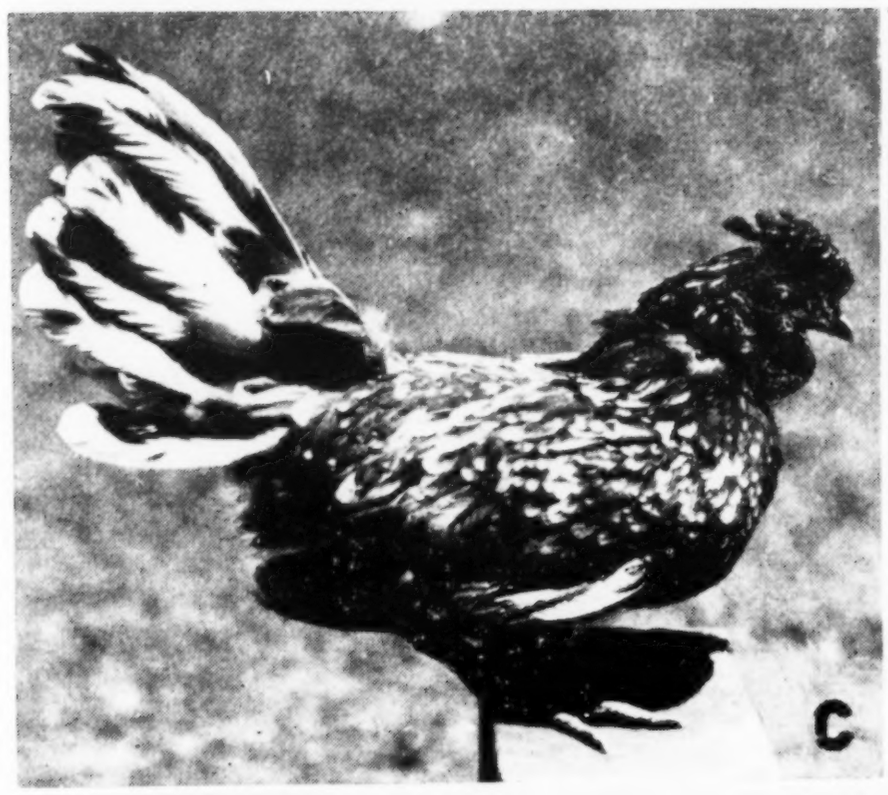
From these results as a whole it seems clear that black and yellow, as such, are not to be considered allelomorphic, but rather the colors which appear as the result of interaction of pattern factors. Black presumably indicates homozygosis of a gene which is similar to, if not actually the same as Dunn's[6] gene $E^m$ for black extension, and yellow the color that appears in the absence of this and the genes for lacing and spangling. On this assumption type 1 has the formula $E^mE^m$, types 2 and 3 are $E^me^m$, and all the others $e^me^m$. If the parent breeds are homozygous for their various traits it would appear that one, probably the Mille Fleur, carries only $E^m$, the other only $e^m$. Probably all individuals of both breeds are homozygous for the capacity to to produce black and yellow pigment in any position that supplementary genes permit. If such is the case the black of Sebrights which meet the standard requirements is due not to $E^m$ but to other factors for black markings.

Besides the black lacing of the first generation, two other forms of black markings have appeared. One gives rise to the pattern in type 4. Here some of the feathers have black spangles like those of a Hamburgh, but in general the spots are crescentic with the concavity directed proximally. Since Morgan[10] pictures a similar feather from his Sebright hybrids, this trait probably comes from that breed. The pattern differs from that of a true Sebright in having the black aggregated toward the tip of the feather instead of forming a regular border.

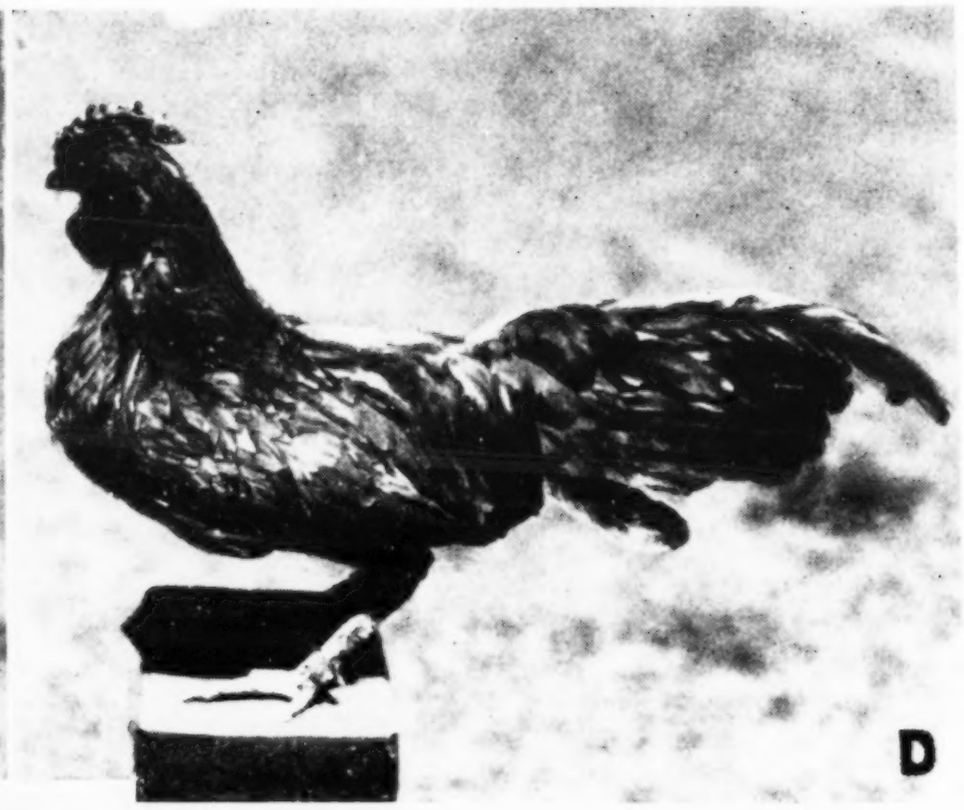
The third form of black marking (type 5) appears as a tiny black spot or pair of spots close to the tip of many feathers of the rump, back, and wings. Thus far it has been definitely recognized only in females, and hen-feathered males with female skin grafts. The trait is variable, even during the life time of the same individual, and may become so much reduced as to render separation of type 5 and 6 at times difficult. In the down, however, the difference is unmistakable, chicks of type 5 being grayish yellow or "roan", those of type 6 clear yellow.

This trait needs further study. Black tips seem to appear most often in feathers grown at other times than following the regular moult. The trait has appeared on one or two occasions following periods of adrenalin injection but the significance of this is doubtful. Perhaps this is a trait with a very even balance between dominance and recessiveness. None of the yellows have shown any approximation to the Rhode Island Red coloring, which in several out-crosses acted as a complete dominant.

White spangling (Figures 20 and 21 *C*, *E*, and *L*), obviously derived from the Mille Fleuer, has behaved as a clear cut recessive except that, especially in association with yellow there has been a considerable increase of white over



C



D

E

F

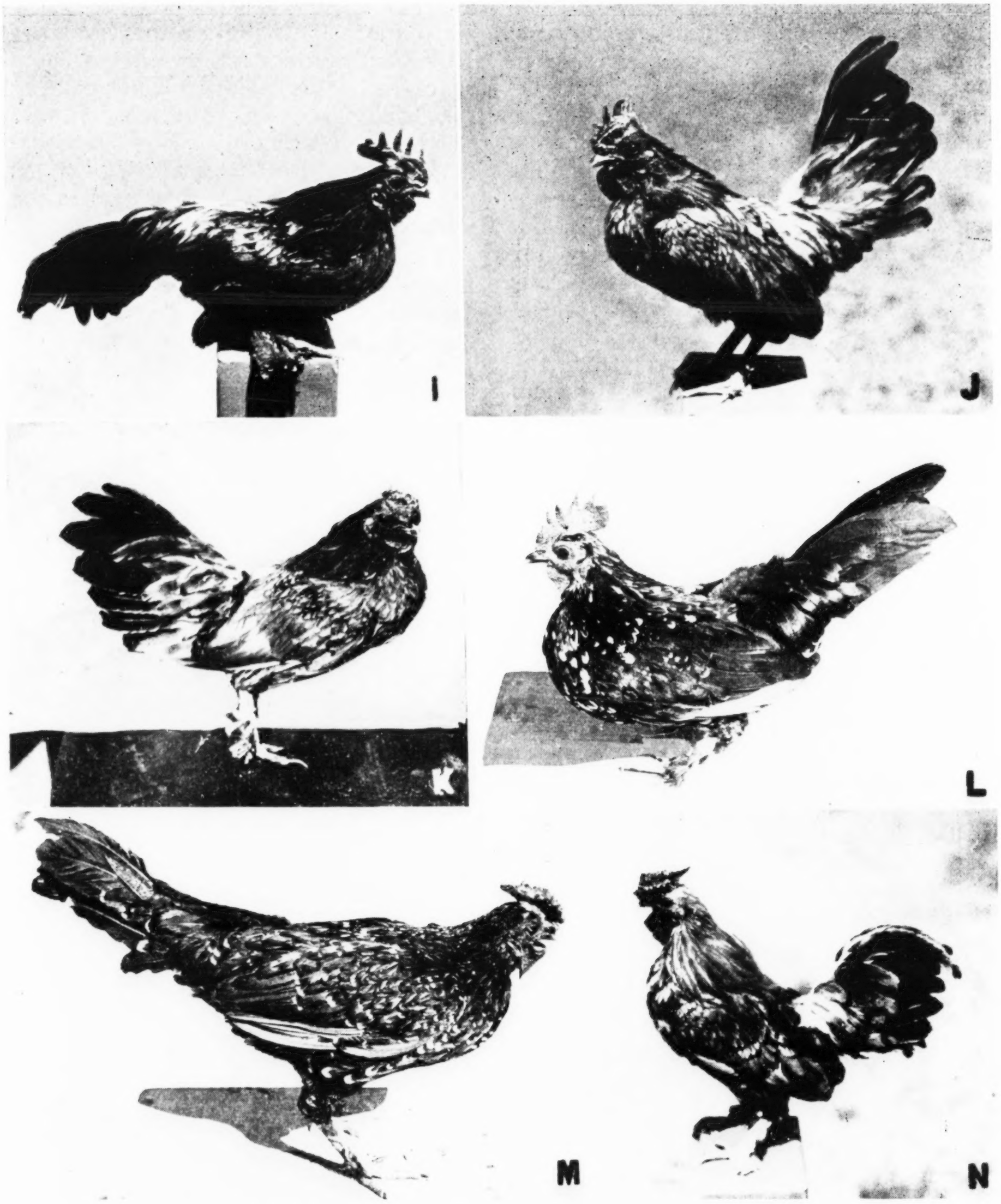
G

H

## SEGREGATES IN LATER GENERATIONS

**Figure 20**

Specimens showing some of the traits discussed in the body of the paper. *C*, rose combed yellow male with white spangling and normal toes. *D*, a cockrel with imperfect male plumage and a slight leg feathering. *E*, a genetically hen-feathered capon. *F*, a female of type 3 ($F_1$). *G*, a genetically cock-feathered capon. *H*, a hen-feathered black male.




## OTHER HYBRID TYPES

**Figure 21**

Continuation of the series begun in Figure 20. *I*, a type 2 male showing heavy booting and large vulture hock. (The light saddle feathers are produced by a graft from *N*.) *J*, a young male with somewhat intermediate type of plumage, as shown by the tail and wing feathers. *K*, a male showing intermediate type of plumage, a new form of comb, and brachydactyly. *L*, a partially castrated black male with white spangling. *M*, a male of type 3 in which spangling was artificially induced by injection of thyroxin (Cf. normal spangling in *L*). *N*, a male of type 4 (The black saddle is from *I*).

that found in the standard coloration. Presumably this spangling is due to the *atrase* gene of Serebrovsky.[13] The black V-shaped border of the white spot, so characteristic of the Mille Fleur and speckled Sussex, has failed to appear in many of the specimens, especially the lighter ones, but whether or not this black border, when present, represents one of the forms of black spangling has not been determined. It is interesting that, at least in heterozygous specimens, the trait is simulated in the new feathers that grow immediately following injection of thyroxin after the method of B. Zawadowsky.[14] The white spangled specimen shown as Figure 21 *M*, was carefully examined before injection and found to show no trace of white on any of his feathers.

The foregoing evidence derived from several variously inbred generations seems to indicate that in a Sebright-Mille Fleur cross the number of heterozygous factors for color and pattern of plumage in the hen phase is small. But this conclusion should be considered as tentative until passable Mille Fleurs and Sebrights shall have been resynthesized.

By means of breeding tests, castration, and skin transplantation, corresponding cocky phases have been determined for each type except 5. They are as follows: (1) black, with a trace of red lacing in hackle, saddle and wings (?); (2) Similar to the preceding, but with more red and with occasional feathers with brown centers; (3) somewhat variable, but mostly comparable to the black and red pattern of the Brown Leghorn males, except for unmodified wing feathers, which show the Sebright pattern; (4) similar to the corresponding femal type except for brighter saddle and hackle feathers, orange on the shoulders, and partial or complete loss of black spangling from most of the modified feathers (Figure 21 *N*) much like the Sebright capon figured by Morgan in his plate (1); (5) presumably indistinguishable from the next; (6) coloration similar to that of a Buff Orpington male except for some black in hackle, primary wing feathers and tail. There is not much difference in the expression of white spangling in the male and female plumage except that it possibly gives way somewhat to red following castration.

The appearance of the black-breasted red coloring (of Davenport[4] and others) in some of the capons and genetically cock feathered males is interesting, since in each of the parent breeds the two sexes have similar breasts. The simplest assumption might be that the primitive black-red pattern of the male is suppressed by different factors in the two breeds, or that its genetic basis has been in part lost by each of them. Since it does not appear in caponized Sebrights (Cf. Morgan,[10] plate 1) but was brought out in an $F_1$ capon of this series, one might infer that in the normally cock-feathered Mille Fleur its inhibition is due to a recessive factor, which would seem to eliminate *tofa* and *tofe* (Serebrovsky[13]) from both breeds. An alternative hypothesis is that these phaenotypically "black-breasted reds" although in some cases presenting very good examples of the pattern, are in reality different, their black breasts being due to release of a melanotic tendency controlled by the $E^m$ gene. Consistent with the latter suggestion is the fact that hen-feathered type 2 and 3 individuals of both sexes seems to darken with age, especially on the breast and rump, and also that no female pattern has occurred that even remotely resembles that usually associated with the black-breasted red in the male. This suggests caution in identifying specimens as black-breasted reds merely on the basis of somatic appearance.

### Hen-Feathering in the Male

The three males in $F_1$ were completely hen-feathered (Figure 19-*B*). In subsequent generations the number of hen-feathered males was high. In addition, there were some males with

good cock plumage and many whose plumage was intermediate. The latter form was sometimes approximated by hen-feathered males after incomplete castration (Figure 19-*A* and 21-*L*). In Campine - Leghorn experiments[3] and possibly in some of the Bantams, intermediate plumage also appeared when skin of a hen-feathered subject grew as a graft on a cock-feathered male host. This suggests that in some instances this represents the resultant of factors in the skin for hen-feathering and in the endocrines for cock-feathering. That a similar picture may be produced by the reciprocal relation is indicated by the appearance of a graft producing henny feathers on a male whose plumage was intermediate. Further breeding and grafting experiments are required to fully elucidate the situation with Bantams, but the necessary clues seem to be at hand.

Heretofore in studies of feather types emphasis has been placed on the endocrine factors. The illuminating experiments of Goodale,[8] Domm,[5] Lillie,[9] Morgan,[10] Pézard,[11] and Zawadowsky[15] have tended to focus attention on these factors as determiners of plumage type, and have led up to the conception of an equal potentiality of the male and female somata in birds. However, the problem involves not only the stimulus but the nature of the response which it elicits. Since feathers which remain henny in the presence of the male hormone become cocky (capon-like) following castration the difference in response would seem to be simply one of threshold. That such is the case is indicated by the skin-grafting experiments referred to above.

The matter of threshold is an important one involving, in one way or another, many different factors. As already noted the gene for a particular pattern may show different grades of expression in different regions of the same bird. This uneven type of reaction is especially noticeable in the the responses associated with presence of amounts of ovarian tissue as perceived by Pézard and clearly recognized by M. Zawadowsky, who points out the sequence in which different regions of the body develop female characteristics with increasing amounts of the hormone. The possibility of hereditary differences in this responsiveness seems to have been ignored.

A study of the Bantams and representatives of several other breeds indicates the existence of a considerable degree of autonomy in different regions as regards the type of feathering. Considering only the tail coverts (sickle feathers) one can select from representatives of the standard breeds a series of at least four grades showing progressively greater degrees of approach to the extreme form of cocky plumage. Such a series might include Sebrights, Campines, Mille Fleurs, and Leghorns. If the same birds were arranged on the basis of hackle development, the order would be different. It might be still different with the respective capons for, despite its hen-feathering, the Sebright apparently carries factors for a fuller tail than that of the cock-feathered Mille Fleur.

Since these types have become standardized for the respective breeds they are evidently hereditary, which means that in addition to the factors whose influence is more or less general these are others with limited action. That these may not be controlled by the gonads is indicated by the character of the tails in *E* and *G*, Figure 20. These are closely related capons which are of the same age and were castrated at the same time so that they should theoretically have the same endocrine balance, and yet their tails are quite different. *E* is genetically hen-feathered, *G* cock-feathered. Of the remaining males shown in Figures 19, 20, and 21, *B*, *C*, *H* and *M* have approximately the female type of plumage examplified by *F*. The feathering in *L* is influenced by partial castration. *J* and *K* are defi-

nitely intermediates, and *D* and *I* (not tested) should probably be regarded as such. *N* showe fairly complete cock-feathering.

The results point to two main factors influencing hen-feathering, one presumably determining the type of endocrine output, the other definitely determining the threshold of response to endocrine stimulation. The sex of the individual influences the effect of the former, and possibly also that of the latter. There also are seen to be other factors that might be called modifiers, which influence the precise grade of cock-feathering if it appears at all.

### Comb Form

One of the Sebright hens in $F_1$ had a single comb, which is a departure from the official requirements for the breed.[1] The Mille Fleur normally has a single comb. In this series rose comb has shown the usual dominance, but several structural deviations have occurred, the most pronounced of which is shown in *K*, Figure 21. Here the comb is of medium height and moderately thick but without the usual points, which are replaced by a few longitudinal ridges. Presumably this is an instance of a latent potentiality being released by crossing.

### Leg Feathering

Feathering of the tarsus, incorrectly called "booting" is an especially interesting trait, particularly in view of its relation to brachydactyly and vulture hock. The original Mille Fleur ancestor of this stock was heavily booted. He was also brachydactyl and had large vulture hocks. The "heel tuft" type of leg feathering described by Serebrowsky was not noticed in this bird or in any of his descendants. The two Sebright hens showed no trace of leg-feathering.

All of the $F_1$ chicks were moderately booted (Figure 19 *A* and *B*). In subsequent generations, some of the descendants had perfectly "clean" tarsi (Figure 20 *H*) like those of a Sebright or Leghorn, others had tarsi that were featherless but with lined or sculptored scales, while the rest, which included the great majority, were booted, some slightly (Figure 21 *J, M, N*), others moderately, and a few (like *I*) as heavily as a true Mille Fleur.

No case was observed in which two parents lacking the trait produced offspring having it. The value of much of the published data bearing on this point is considerably impaired by a general failure to recognize that the trait is one which primarily effects a modification of the tarsal scales and that it is this which is usually accompanied by the development of feathers. Lack of appreciation of the nature of the trait may lead a student to classify his specimens in a purely artificial manner.

In the Sebright-Mille Fleur descendants the degree and uniformity of the manifestation in $F_1$ and its range in later generations could hardly be interpreted on a single factor hypothesis. But the observations are all consistant with the assumption that there are involved two pairs of allelomorphs whose action is blending and cumulative, Mille Fleurs having the formula *AABB;* Sebrights, *aabb.*

### Brachydactyly

By brachydactyly, which was first observed in larger breeds and described by the writer several years ago,[2] is meant a condition in which the fourth toe is shorter than the second (Figure 21 *K*) instead of being longer as it normally is. In many Cochins and Brahmas the number of bones in the fourth toe is reduced from five to four, three, or even two. Although embryologically shortening of the fourth toe is apparent before the feather follicles develop, booting and brachydactyly are intimately related, and probably have the same genetic background. On the whole they fluctuate together, but occasionally a booted bird has full length toes or a brachydactyl one shows nothing more than sculpturing of some of the tarsal scales. Both embryologically

and genetically the Bantams have conformed to the findings for the larger breeds, from which it may be inferred that the brachydactyly of Mille Fleur origin is the same as that of the Cochin and Brahma. If there are two different genes for booting, it is probable, from the evidence, that each of them tends to produce brachydactyly.

### Vulture Hock

In the Mille Fleur there is a large tuft of coarse feathers which arises from the lower part of the leg ("lower thigh") and projects backward beyond the heel ("knee"). This is called a "vulture hock". It is not present in the Sebright. In the $F_1$ individuals it was only feebly indicated (Figure 19 *A* and *B*). In subsequent generations there were apparently three grades of manifestation: slight ($F_1$ type), medium (Figure 20, *E*, *F*, *G*) and pronounced (21-*I*). In this material, as in that studied by Dunn, the trait never appeared in the absence of booting, and the most pronounced development occurred only in individuals having a heavy boot (Figure 21 *I*). On the other hand many booted individuals showed no trace of a vulture hock, from which it may be inferred that the traits are not linked, but that vulture hock merely requires the genetic background for booting before it can manifest itself. If this interpretation is correct, it would appear that the trait is incompletely dominant ("blending") showing, in booted individuals, a slight manifestation when heterozygous, and when homozygous a medium or pronounced manifestatoin, depending on the grade of booting. The data throw no light on the transmission of the trait through non-booted individuals.

### Size

The original Mille Fleur cock weighed 750 grams (27 oz.) and the two Sebright hens weighed 440 grams and 460 grams. According to the "American Standard of Perfection" this is one ounce over-weight for the cock and 6-7 ounces under-weight for the hens. One $F_1$ ccok reached 1060 grams and one of the hens weighted 550 grams. In later generations, recorded weights for cocks ranged from 620 grams to 900 grams and for hens from 264 grams to 740 grams. This shows that some of the hybrids were larger and some smaller than normal representatives of either parental breed, which suggests that the factors for size are not all identical in Sebrights and Mille Fleurs. One midget which possibly got all the genes for smallness, although now over two years old, has never reached a weight of ten ounces. A Bantan-White Leghorn and three Bantam-Rhode Island Red crossbreeds were all of about the same size—intermediate between Leghorns and Bantams, but nearer the Bantams than the Reds. These results are in a general way comparable to those of Punnett[12] in his studies of size in a Sebright-Hamburgh cross.

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## The New Benevolence

IN many cases man walks hand-in-hand with Nature, studying her laws, acting in accordance with them, combining them favourably to his purposes, and reaps a harvest of benefit. But in others he tampers unwisely with her canons, opposes himself directly to her precepts, and is, in the end, hurled back bleeding or ground to powder in the attempt. In regard to human population he has been inclined to adopt this latter course. In endeavouring to conserve *all* life, he has neglected the strict doctrines of Nature concerning which particular forms of life are to be favoured and which discarded. This path is entrenched with danger. To it he is led by his feelings of sympathy and benevolence—noble qualities when rightly understood and employed with a becoming discernment, but, misapplied, only too apt to produce results exactly contrary to those intended.

We must discriminate between the benevolence that is merely apparent and that which is really beneficial; between that which exhausts itself upon symptoms and that which goes to the root of things and deals with causes; between the short-sighted variety—to palliate the present at any cost—and that which concerns itself not only with the present, but has an earnest regard for the future also. For to confer some degree of seeming benefit upon the few of the present, whereby the general happiness and progress of the many of the future would be sacrificed, is scarcely to perform a good work. In short, it is clearly the function of the benevolence to meliorate existing poverty and distress, especially when resulting from misadventure transcending the powers of human foresight, but it must set its face resolutely against the multiplication of any showing transmissible hereditary taints. Such a just attitude has little in common with a species of pallid sentimentalism—very prevalent among us today. It is a sinister fact that our moral code has so little regard for the physical and mental equipment of future generations. The warnings of science are disregarded. And this is the rift in our armour which, if not remedied by determined action, will doubtless suffice to send modern civilization tottering to its doom.—WHITE, FRANK W., *Posterity in the Light of Science, Philanthropy, and Population*, pp. 43-44. London, Watts & Co. 1929.

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